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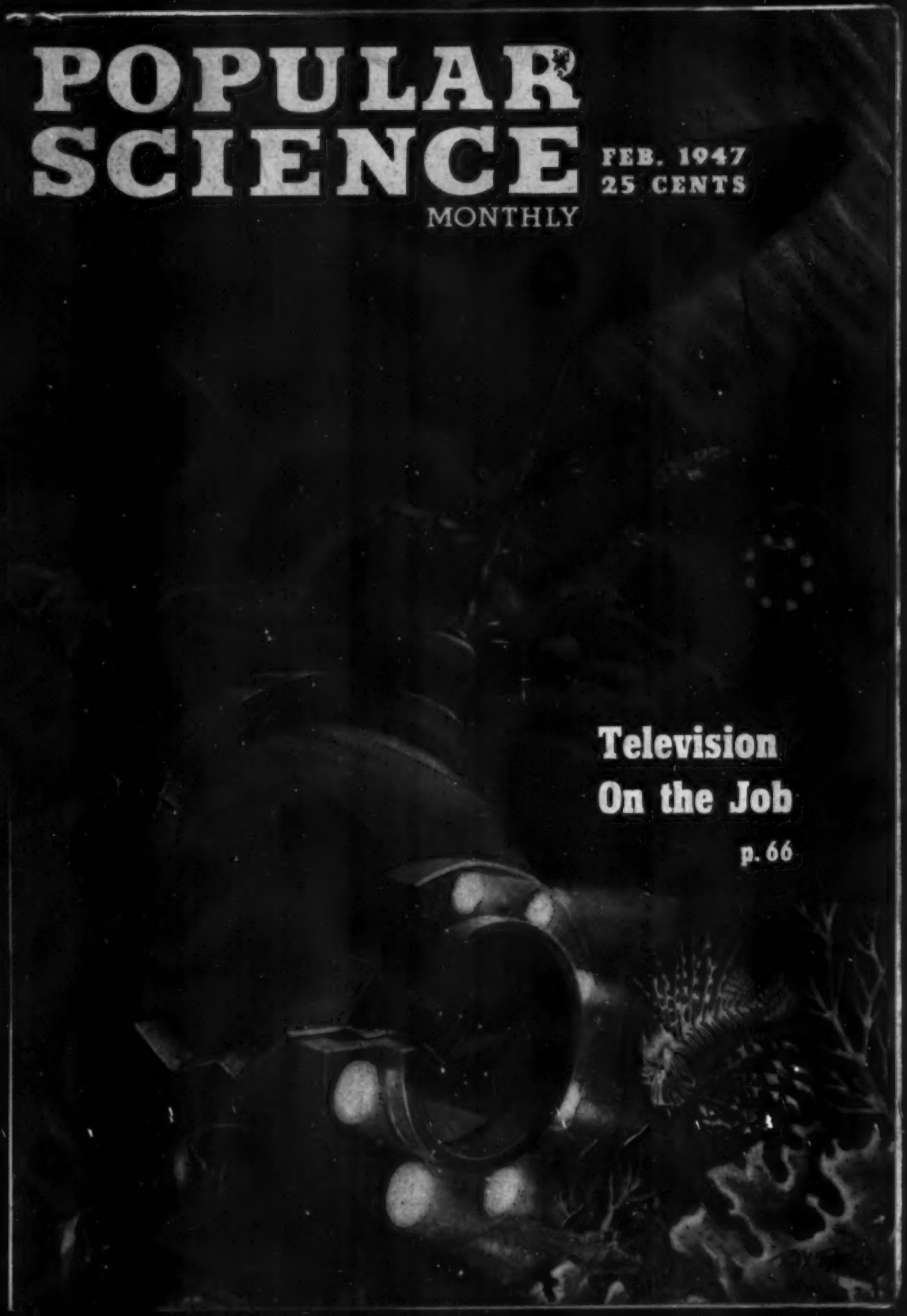

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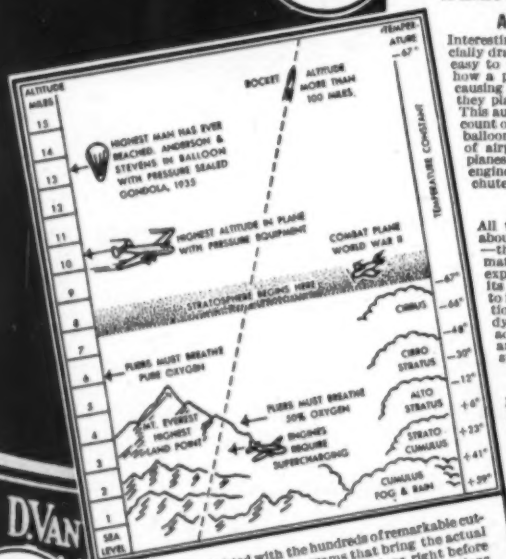

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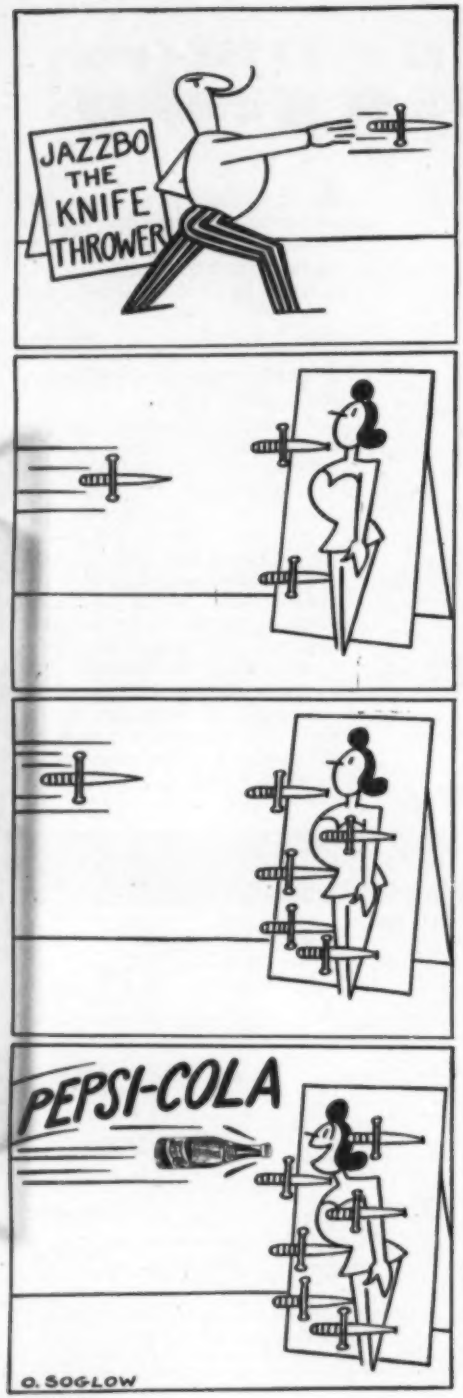

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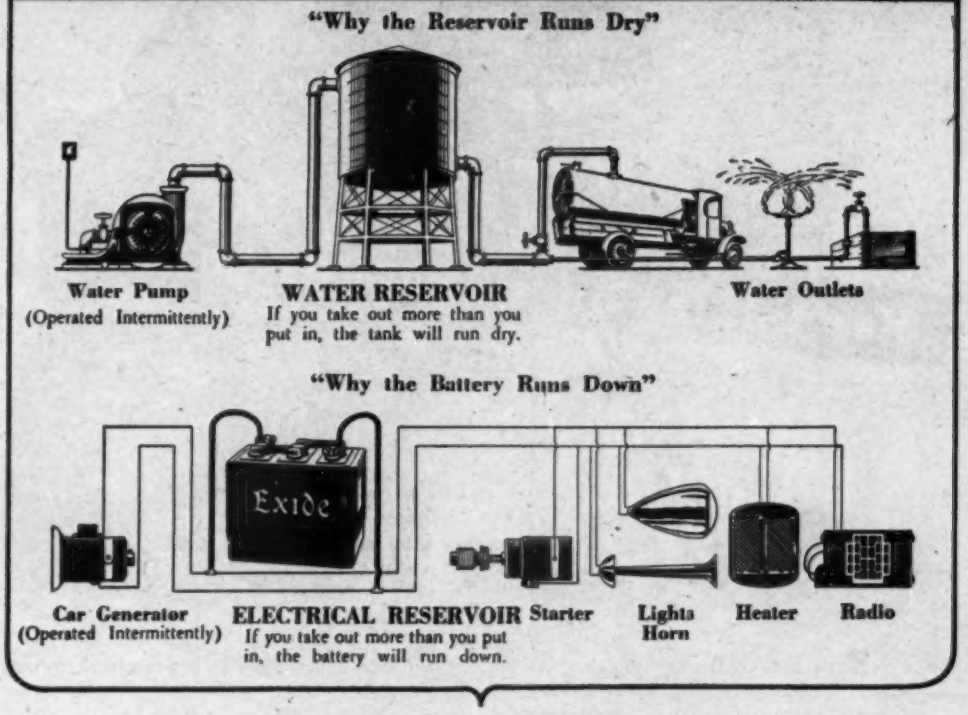

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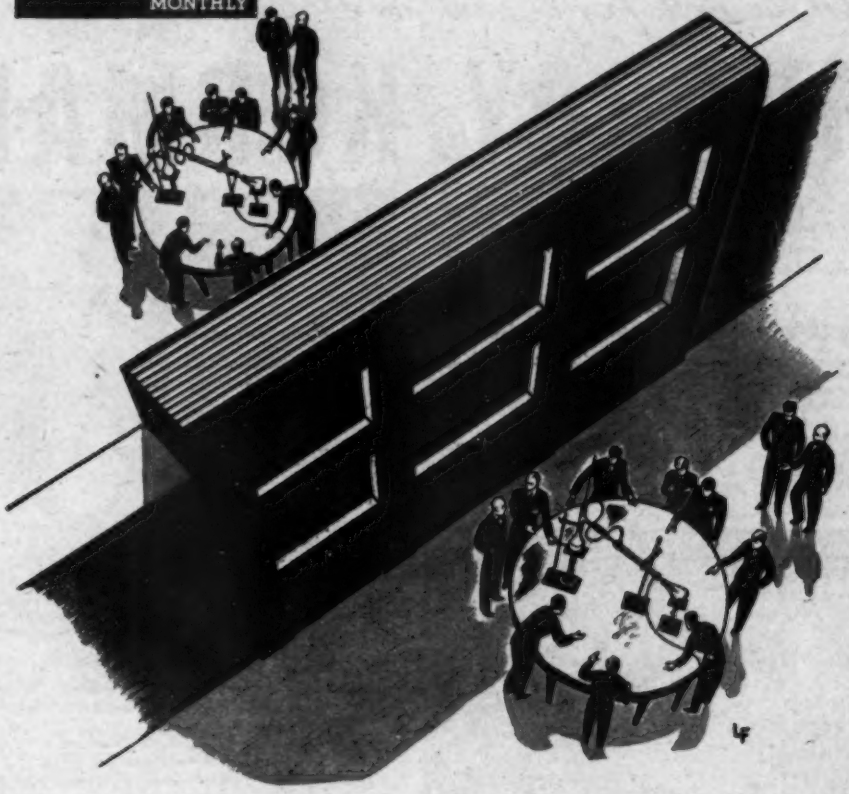

Must Science Have Iron Curtains?

"COMPARTMENTALIZATION" is just a twenty-letter dirty word to true scientists. It stands for the separate, and usually secret, pursuit of the same knowledge by different groups. During the war it became an iron curtain which cut off the glow of ideas as effectively as any other boiler-plate drapery.

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Our training is tried and proven—and what you study at home you can use on the job right away. Perhaps right in your own company there is a great opportunity to advance—to get an executive job with the prestige and money that go with such advancement.

The way to success is not magic. It requires study, and you will have to be willing to work earnestly—thoroughly.

But wouldn't it be worth your while to trade some of your leisure over a comparatively brief period for a bigger job and more money?

Why not be somebody in the business world—why be satisfied to go through life in a small job at small pay when the way to success is clearly marked. The years are going by very fast—and it's high time you did something concrete about your future.

The coupon below will bring you complete information about the field of your choice. SEND IT TODAY. Don't delay—it can be the turning point in your career to a better job and more money.

G. I. APPROVED

LASALLE Extension University
a Correspondence Institution
Dept. 283-R Chicago 5, Ill.

I want to better my position—make more money. Send me your free booklet on the field I have checked below.

- ☐ Higher Accountancy
- ☐ Industrial Management
- ☐ Executive Management
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- ☐ Law L. L. B. Degree

Name.....*Age*.....

Present Position.....

City, Zone and State.....

J. E. SMITH, President
National Radio Institute
The man who has directed the Home Study Training of more men for the Radio Industry than any other man in America.

BE YOUR

I will show you how to start a Radio Service Business

Full Time or Spare Time ***without capital***

VETERANS:

You can get this training right in your own home under G.I. Bill. Mail coupon for full details.

I Trained These Men

$80 A Month in Spare Time

"I have a spare time Radio and Electrical business of my own which has been very profitable, due to the efficient training I received from your Course. Last year I averaged over $80 a month."—FRED H. GRIFFIE, Rt. 3, Newville, Pa.

Fixing Radios Profitable Hobby

"I am doing Radio work in my spare time and find it a profitable hobby. My extra earnings run about $10 a week. I certainly am glad I took your N. R. I. Course." — FERDINAND ZIRBEL, Chaseley, N. Dak.

MY COURSE INCLUDES

TELEVISION

ELECTRONICS

FREQUENCY MODULATION

SAMPLE LESSON FREE

SEE OPPOSITE PAGE

Do you want a good-pay job in Radio—or your own money-making Radio Shop? Mail Coupon for a FREE Sample Lesson and my FREE 64-page book, "How to be a Success in RADIO—Television, Electronics." See how N.R.I. gives you practical Radio experience at home — building, testing, repairing Radios with BIG KITS OF PARTS I send!

Many Beginners Soon Make Good Extra Money in Spare Time While Learning

The day you enroll I start sending EXTRA MONEY JOB SHEETS. You LEARN Radio principles from my easy-to-grasp, illustrated lessons—PRACTICE what you learn with parts I send—USE your knowledge to make EXTRA money fixing neighbors' Radios in spare time while still learning! From here it's a short step to your own *full-time* Radio Shop or a good Radio job!

Future for Trained Men is Bright in Radio, Television, Electronics

It's probably easier to get started in Radio now than ever before because the Radio Repair business is booming. Trained Radio Technicians also find profitable opportunities in Police, Aviation, Marine Radio, Broadcasting, Radio Manufacturing, Public Address work. Think of even *greater* opportunities as Television and Electronics become available to the public!

Find Out What N. R. I. Can Do For You

Mail Coupon for Sample Lesson and my 64-page book. Read the details about my Course. Read letters from men I trained, telling what they are doing, earning. See how quickly, easily you can get started. No obligation! Just MAIL COUPON NOW in an envelope or paste it on a penny postal. J. E. SMITH, President, Dept. 7BP3, National Radio Institute, *Pioneer Home Study Radio School*, Washington 9, D. C.

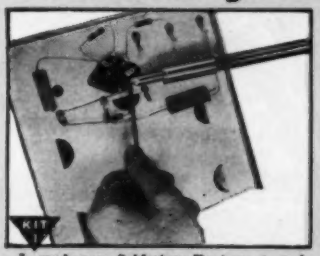
Our 33rd Year of Training Men for Success in Radio

A TESTED WAY

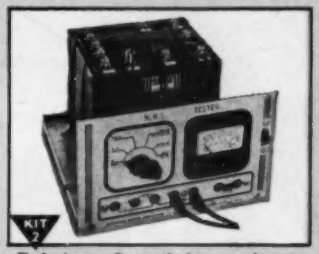
OWN BOSS

LEARN RADIO BY PRACTICING IN SPARE TIME

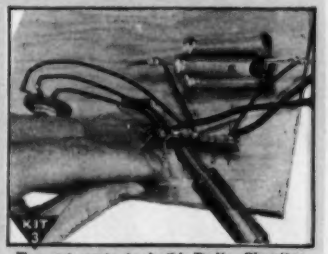
with Big Kits of Radio Parts I Send You!



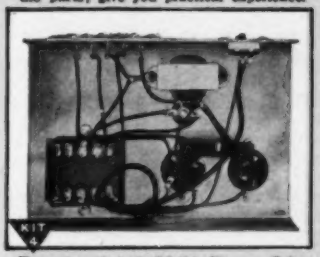
I send you Soldering Equipment and Radio Parts; show you how to do Radio soldering; how to mount and connect Radio parts; give you practical experience.



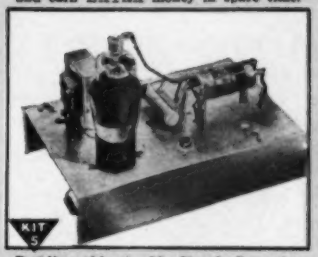
Early in my Course I show you how to build this N.R.I. Tester with parts I send. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.



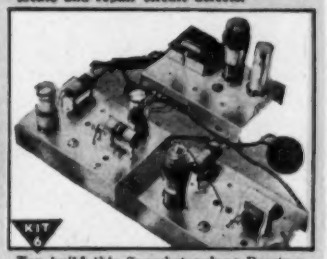
You get parts to build Radio Circuits; then test them; see how they work; learn how to design special circuits; how to locate and repair circuit defects.



You get parts to build this Vacuum Tube Power Pack; make changes which give you experience with packs of many kinds; learn to correct power pack troubles.



Building this A. M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.



You build this Superheterodyne Receiver which brings in local and distant stations—and gives you more experience to help you win success in Radio.

SAMPLE LESSON FREE

I will send you a FREE Lesson, "Getting Acquainted with Receiver Servicing," to show you how practical it is to train for Radio at home in spare time. It's a valuable lesson. Study it—keep it—use it—without obligation! Tells how Superheterodyne Circuits work, gives hints on Receiver Servicing, Locating Defects, Repair of Loudspeaker, I.F. Transformer, Gang Tuning, Condenser, etc. Thirty-one illustrations.

TO GOOD PAY

MAIL COUPON FOR FREE LESSON AND 64-PAGE BOOK

Good for Both FREE

Mr. J. E. SMITH, President, Dept. 7BP3
National Radio Institute, Washington 9, D. C.

Mail me FREE, without obligation, Sample Lesson and 64-page book about how to win success in Radio—Television, Electronics. (No salesman will call. Please write plainly.)

Age.....

Name.....

Address.....

City..... Zone..... State.....

Approved for Training under GI Bill

. . . IS MIND POWER REAL?

HAVE YOU READ volumes on the power of thought? Perhaps you have listened to lengthy theoretical addresses on the forces of mind. You may have wondered if these same writers and lecturers on mind power know how to use it. How many mountains of personal obstacles—everyday trials and tribulations—have *they* moved? What are these subtle principles whereby man can skillfully remove the barriers that impede his progress? How can *you* displace the obstructions and hindrances to *your* goal...the mountains in *your* life? Can practical information about inner power be reduced to mere words...words for public dissemination? Or, is there a secret method especially and uniquely preserved for the worthy seeker...practicable only under ideal circumstances? If so, who has the secret method? Where can it be found?

Investigate the Rosicrucians (NOT a religion), the oldest *practical* pholosophical fraternity on earth. See if they cannot show you a method for attainment such as you may not have dreamed. Thousands of men and women today are enjoying mental mastery...realization of ideals...the attainment of their objectives. They *know* the secret methods for converting mountains of personal problems into green valleys of achievement.

ACCEPT THIS OFFER

A FREE book, *The Mastery of Life*, is yours for the asking. It explains how easily you may enter upon the path of attainment. Fill in and send coupon *today!*

SCRIBE M. H. B.
THE ROSICRUCIANS (AMORC)
San Jose, California

Please send me the book, *The Mastery of Life*, which explains how I may learn to use my faculties and powers of mind.

Name_____

Address_____

City_____

Zone Number_____ State_____

The
ROSICRUCIANS (AMORC) San Jose, California

What's My Job?—I Manufacture Weaklings into MEN!

Charles Atlas

Actual photograph of the man who holds the title "The World's Most Perfectly Developed Man."

GIVE ME a skinny, pepless, second-rate body—and I'll cram it so full of handsome, bulging new muscle that your friends will grow bug-eyed! . . . I'll wake up that sleeping energy of yours and make it hum like a high-powered motor! Man, you'll **feel** and **look** different! You'll begin to **LIVE!**

Let Me Make YOU a NEW MAN —IN JUST 15 MINUTES A DAY!

YOU wouldn't believe it, but I myself used to be a 97-lb. weakling. Fellows called me "Skinny." Girls snickered and made fun of me behind my back. I was a flop. THEN I discovered my marvelous new muscle-building system—"*Dynamic Tension.*" And it turned me into such a **complete** specimen of MANHOOD that today I hold the title "THE WORLD'S MOST PERFECTLY DEVELOPED MAN."

That's how I traded in my "bag of bones" for a barrel of muscle! And I felt so much better, so much **on top of the world** in my big, new, husky body, that I decided to devote my whole life to helping **other** fellows change themselves into "perfectly developed men."

What Is "*Dynamic Tension*"? How Does It Work?

When you look in the mirror and see a healthy, husky, strapping fellow smiling back at you—then you'll be astounded at how **short** a time it takes "*Dynamic Tension*" to GET RESULTS!

"*Dynamic Tension*" is the easy, NATURAL method you can practice in the privacy of your own room—JUST 15 MINUTES EACH DAY—while your scrawny shoulder muscles begin to swell, ripple . . . those spindly arms and legs of yours bulge . . . and your whole body starts to feel "alive," full of zip and go!

One Postage Stamp May Change Your Whole Life!

As I've pictured up above, I'm steadily building broad-shouldered, dynamic MEN—day by day—the country over.

2,000,000 fellows, young and old, have already gambled a postage stamp to ask for my FREE book. They wanted to read and see for themselves how I'm building up scrawny bodies, and how I'm paring down fat, flabby ones—how I'm turning them into breath-taking human dynamos of pure MANPOWER.

Take just a few seconds NOW to fill in and mail the coupon at right, and you will receive at once my FREE book—"Everlasting Health and Strength" that PROVES with actual snap-shots what "*Dynamic Tension*" has done for others—what it can do for YOU! Address: CHARLES ATLAS, Dept. 12, 115 East 23rd Street, New York 10, N. Y.

FREE

Mail the coupon below right now for my FREE illustrated book, "Everlasting Health and Strength." Tells all about "*Dynamic Tension*" methods. Crammed with pictures, facts! Address me personally: CHARLES ATLAS, Dept. 12, 115 E. 23rd St., New York 10, N. Y.

MAIL COUPON FOR FREE BOOK

CHARLES ATLAS, Dept. 12
115 East 23rd St., New York 10, N.Y.

I want the proof that your system of "*Dynamic Tension*" will help make a New Man of me—give me a healthy, husky body and big muscular development. Send me your free book, "Everlasting Health and Strength."

Name.....
(Please print or write plainly)

Address.....

Zone No.
City.....(if any)...State.....

☐ Check here if under 16 for Booklet A.

NOW SPRAYBERRY RADIO TRAINING GIVES YOU 8 BIG KITS OF RADIO EQUIPMENT

WITH A COMPLETE 6 TUBE SUPER-HETERODYNE RECEIVER

YOU LEARN RADIO SERVICING THROUGH INTENSIVE "SHOP-BENCH" PRACTICE

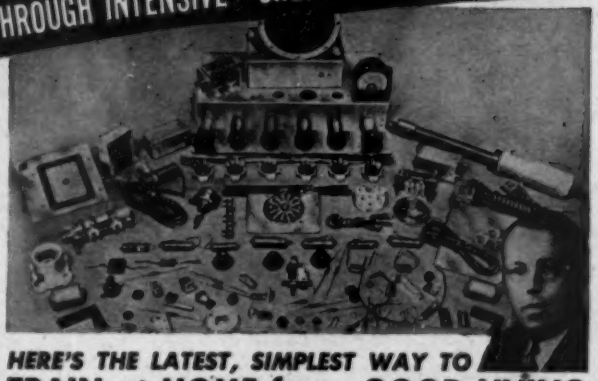
YOU DO EXPERIMENTS, CONSTRUCTION, TROUBLE-SHOOTING

I'll show you how to perform over 175 instructive Experiments—how to build countless Radio Circuits. You'll learn a new, fast way to test Radio Sets without only Equipment.

I give you a fine, moving-coil type Meter Instrument on Jewel Bearings—with parts for a complete Analyzer Circuit Continuity Tester. You learn how to check and correct Receiver defects with professional accuracy and speed.

You'll get valuable experience and practice building this Signal Generator and multi-purpose Tester. Makes a breeze out of fixing Radios and you don't have to spend money on outside, ready-made equipment.

Soldering, wiring, connecting Radio parts . . . building circuits with your own hands—you can't beat this method of learning. When you construct this Rectifier and Filter, Resistor and Condenser Tester, etc., you get a really practical start on Radio that leads to a money-making future.



HERE'S THE LATEST, SIMPLEST WAY TO TRAIN at HOME for a GOOD LIVING in RADIO-ELECTRONICS & TELEVISION

I train your *mind* by putting you to work with your hands on a big 6-Tube Superheterodyne Receiver. And, believe me, when you get busy with real Radio Parts — 8 big Kits of them — you really LEARN Radio, and learn it RIGHT! You get the practical stuff you need to be *useful* in Radio, and that's what it takes to make money. You don't have to worry about what to do with these 8 Kits of Parts. Step by step, I show you how to build circuits, test, experiment, trouble-shoot. And you don't need any previous experience. The Sprayberry Course starts right at the beginning of Radio! You can't get lost! Simplified lessons, coupled with real "Shop" practice, makes every subject plain and easy to understand and remember.

A BUSINESS OF YOUR OWN . . . OR A GOOD RADIO JOB

Soon after you begin Sprayberry Training, I'll send you my sensational BUSINESS BUILDERS. You'll find out how to get and do neighborhood Radio repair jobs for nice profits and rich experience while learning. This sort of work can easily pave the way for a Radio Service business of your own. But with Sprayberry Training, you're not limited. You can swing into any one of the swiftly expanding branches of Radio-Electronics (INCLUDING Radio, Television, FM, Radar, Industrial Electronics. Be wise! Decide now to become a fully qualified RADIO-ELECTRONICIAN. Get full details about my Training at once! Mail coupon below for my 2 big FREE Books.

SEND FOR THESE FREE BOOKS

"How to Read Radio Diagrams and Symbols"

Here's a valuable and wonderfully complete new book which explains in simple English how to read and understand any Radio Set Diagram. Includes translation of all Radio symbols. Send for this volume at once! It's free! Along with it, I will send you another Big Free book describing in detail my Radio-Electronic Training.

MAIL COUPON TODAY!

SPRAYBERRY ACADEMY OF RADIO
P. L. Sprayberry, President, Room 5527 Pueblo, Colorado

Please rush my FREE copies of "How to MAKE MONEY in RADIO, ELECTRONICS and TELEVISION," and "HOW to READ RADIO DIAGRAMS and SYMBOLS."

Name _____ Age _____

Address _____

City _____ State _____

(Mail in envelope or paste on penny postcard)

INVENTORS

The patent laws provide that any new and useful art, machine, article of manufacture, composition of matter, or design, or any new and useful improvement thereof, may be patented if the act of invention is involved. Therefore, every inventor with a valuable invention should take advantage of the patent laws and proceed for patent protection in order to safeguard his rights.

A patent gives the inventor the exclusive right to prevent others from making, using, or selling the invention claimed in the patent for a period of 17 years.

The patent laws were enacted for the benefit of the inventor to give him protection for the features of his invention which are patentable. These features must be properly and concisely set forth and claimed in a formal application for patent in order to comply with the requirements of the U. S. Patent Office. For that reason, the Patent Office advises the inventor to engage a competent registered patent attorney to prepare his application for patent and represent him before the U. S. Patent Office Examiner.

A specially prepared booklet containing detailed information with respect to patent protection and procedure will be forwarded to you without obligation upon request.

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CLARENCE A. O'BRIEN & HARVEY B. JACOBSON
Registered Patent Attorneys
72-B District National Bldg., Washington 5, D. C.

Please send me booklet containing information regarding patent protection and procedure, and also "Record of Invention" form. This request does not obligate me.

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Address_____

City_____ State_____

(Please write or print plainly.)

PYROIL an old friend for your NEW CAR!

Automobiles get old first inside. Metal to metal contact of piston and cylinder means wear . . . corrosion . . . deterioration. Pyroil gives oil the quality of adhering to cylinder walls . . . of providing constant lubrication to prevent metal to metal contact and wear. Pyroil makes starting easier and reduces battery drain. Whether you are the proud owner of a new car or still driving a pre-war model . . . you will get added miles by adding Pyroil. Ask your gas station attendant.

PYROIL FOR AIRCRAFT ENGINES

Use Aircraft Pyroil B for lubricating oil, Aircraft Pyroil A for gasoline.
Manufactured and Guaranteed by Pyroil Company, 198 Main Street, La Crosse, Wisconsin.

PYROIL COMPANY
198 Main Street, La Crosse, Wisconsin .
I want my car to last and run properly. Please tell me more about Pyroil and how it can accomplish this for me.

Name.....

Address.....

City or Town.....State.....

Jerry, the talking dog, is entertaining hospitalized veterans, by courtesy of the PYROIL Company. Picture of Jerry, sent on request.

LETTERS

JATO in Reverse

Sir:

In the progress that aviation has made, it has fallen short in one step: slowing down a plane once it has touched the ground, especially in an emergency. . . . One method I would like to suggest, in which I have failed to observe an experimenting, is utilizing the braking effect of rockets to retard forward motion. . . .

W. G. Dixon

Phoenix, Ariz.

Reader Dixon's suggestion has been echoed by an engineer attending the American Rocket Society convention, so experiments may follow soon.

Dreamboat's Runway

Sir:

Your article on the Dreamboat states that by building a 100-foot section of runway, they linked the Navy's John Rodgers Field and the Army's Hickam Field. A pal of mine who was stationed there contends this is not possible since the two runways are parallel. . . .

Ross E. Roach

Grand Island, Neb.

The runways themselves are parallel, but the fields were joined by connecting the runway of one with a wide taxiway on the other to make a continuous take-off strip.

Dreamboat's Green Light

Sir:

In your December article on the flight of the Pacusan Dreamboat, Col. Irvine mentions seeing a green cast over the rising Arctic sun, which he attributed to the prismatic effect of ice crystals. The "green ray," as this curious coloring is called, can be seen at sunset or sunrise when the sun's rim is just above the horizon. . . . The colors in the sun's spectrum are refracted in the

INVENTORS

Patent Laws Encourage The Development Of Inventions

The Rules of Practice of the U. S. Patent Office advises—unless an inventor is familiar with such matters—that he employ a competent registered attorney, as the value of patents depends largely upon the skillful preparation of the specifications and claims.

The firm of McMorrow, Berman and Davidson is registered to practice before the U. S. Patent Office. Additionally, it maintains a staff of attorneys able to readily understand inventors' disclosures, to advise concerning patentability, and to prepare appropriate specifications and claims for filing with the Patent Office.

If an inventor believes he has an invention, a search of the most pertinent prior U. S. patents should be made and a report obtained relative to its patentability. Where such report indicates that the invention appears patentable, in order to secure protection, diligence should be exercised in making application for a patent.

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PATENTS — TRADE MARKS — COPYRIGHTS

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1421 Victor Building, Washington 1, D. C.

Send me further particulars as to patent protection and procedure and "Invention Record" form at once. I understand that this request does not obligate me.

Name.....

Address.....

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(WRITE OR PRINT NAME CLEARLY)

Sells 95 Stories and Novelettes

"The introduction you gave me to your editor friend, resulting in my present assignment to do a complete novel for him monthly, is doubly appreciated, especially since I finished my N.I.A. training some time ago and, consequently, have no call on your service. Here is concrete evidence that interest in your students continues indefinitely. To date now, I have sold 95 stories and novelettes to 20 national magazines."—Darrell Jordan, P.O. Box 279, Friendship, New York.

Why Can't You Write?

It's much simpler than you think!

SO many people with the "germ" of writing in them simply can't get started. They suffer from inertia. Or they set up imaginary barriers to taking the first step.

Many are convinced the field is confined to persons gifted with a genius for writing.

Few realize that the great bulk of commercial writing is done by so-called "unknowns." Not only do these thousands of men and women produce most of the fiction published, but countless articles on business affairs, social matters, sports, hobbies, travel, shop crafts, local, club and church activities, etc., as well.

Such material is in constant demand. Every week thousands of checks for $25, $50 and $100 go out to writers whose latent ability was perhaps no greater than yours.

The Practical Method

Newspaper work demonstrates that the way to learn to write is by writing! Newspaper copy desk editors waste no time on theories or ancient classics. The *story* is the thing. Every copy "cub" goes through the course of practical criticism—a training that turns out more successful authors than any other experience.

That is why Newspaper Institute of America bases its writing instruction on the Copy Desk Method. It starts and keeps you writing in your own home, on your own time. And upon the very same kind of *actual assignments* given daily to metropolitan reporters. Thus you learn by *doing*, not by studying the individual styles of model authors.

Each week your work is analyzed constructively by practical writers. Gradually they help to clarify your own *distinctive* style. Writing soon becomes easy, absorbing. Profitable, too, as you gain the "professional" touch that gets your material accepted by editors. Above all, you can see constant progress week by week as your faults are corrected and your writing ability grows.

Veterans:

Course approved for Veterans' Training

Have You Natural Ability?

Our Writing Aptitude Test will reveal whether or not you have natural talent for writing. It will analyze your powers of observation, your imagination and dramatic instinct. You'll enjoy taking this test. There is no cost or obligation. Simply mail the coupon below, today. Newspaper Institute of America, One Park Avenue, New York 16, N. Y. (Founded 1925)

Free

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Send me, without cost or obligation, your *Writing Aptitude Test* and further information about writing for profit as promised in Popular Science, February.

Mr. / Mrs. / Miss .....

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following order: violet, blue, green, yellow, orange and red. The rising sun's crescent would be visible first in violet and blue, but the eye is insensitive to these colors. Green, however, affects the eye strongly. . . . Hence we see the sun first in green if the air is transparent enough and the horizon low enough for a pronounced refraction. The crew of the Dreamboat had perfect conditions for observing this rare phenomenon 20,000 feet in the Arctic air.

The weather forecasts for the flight were issued from this AAF Main Weather Central; the problem of preparing forecasts for the 10,000-mile route through the world's worst weather zones would make quite a story in itself.

ALBERT D. ANDERSON

Air Weather Service
Washington, D. C.

PSM feels there is also quite a story in the preparation of "over-the-top" routes for commercial air lines. *See page 76.*

Set Right on Racers

Sir:

Just read your December article on midget racers and wish to point out a common mistake. No. 4 in the illustration on page 134 is not an oil pump; it provides air pressure to force gas from tank to carburetors.

NORBERT M. PHILSON

Philadelphia, Pa.

PSM regretfully admits the error, blushes for its being a "common" one.

Day After Tomorrow?

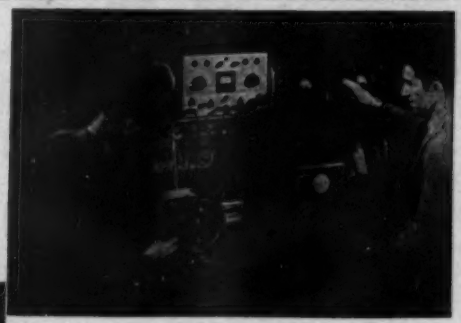
Sir:

Your November issue illustrates "Tomorrow's Gas Station." It is all very good except that you show a man pumping gas in the same old way—holding the hose and waiting for the tank to fill (and perhaps run over.) It would not seem too much to expect "tomorrow" to have an automatic shut-off on the gas hose nozzle. As a matter of fact, there is a gas station in Darien, Conn., equipped with home-made valves that shut off the flow when a car's tank is full.

HENRY F. ROBBINS

New York, N. Y.

Learn RADIO-ELECTRONICS-TELEVISION



RADIO TESTING AND SERVICING—Students learning to locate troubles with modern radio analyzers.

ELECTRONIC CIRCUIT TESTING — Instructor showing students use of large Cathode Ray Oscilloscope.

TRAIN FOR A GOOD JOB NOW *one that offers* STEADY WORK *with a* REAL FUTURE

Don't be caught napping. Prepare for a good job now that will still be a good job with a real future when conditions change. If you are not a trained man you may have to compete with millions of other untrained men. Get into a field that offers real opportunities in good-times and bad-times. Tremendous expansion in Frequency Modulation and Television is predicted because of war time discoveries now being re-converted to civilian use. Radio-Electronics trained men are needed today—they will be needed in the years ahead!

"Learn by Doing"

RIGHT HERE in the SHOPS of COYNE—in a Few Weeks

Student Finance Plan

We train you on real Radio, Television and Sound equipment—RIGHT HERE IN THE COYNE SHOPS IN CHICAGO. Necessary theory is given in a practical way by practical lectures, blackboard illustrations and equipment demonstrations. **Whether or not you have had Radio experience you need Coyne all-around Radio Electronics training.** Many of our students had no previous experience. Others had experience in one or two branches but **realized they needed all-around training for better jobs and advancement.**

EARN WHILE LEARNING

If you need part-time work to help pay living expenses while at school, we will help you get it. **Coyne** graduates also receive a **Life Membership** with **Lifetime Employment Service.**

MEN WITH PHYSICAL DISABILITIES—whether due to war or other causes—we also have facilities for you. **Check coupon for particulars if you have a physical disability of any nature.**

PREPARE FOR JOBS LIKE THESE

Radio Servicing
Radio Sales
Radio Manufacturing
Factory Inspecting and Testing
Auto Radio Installation & Servicing
Sound and Public Address, etc.
Your Own Radio Shop

Electric Refrigeration Now Included

ADDED TRAINING

This training included to help you get ready for the better jobs in this great field

THE HOME OF COYNE

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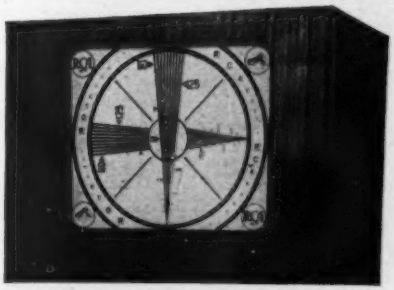

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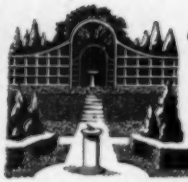

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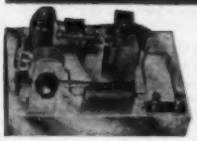

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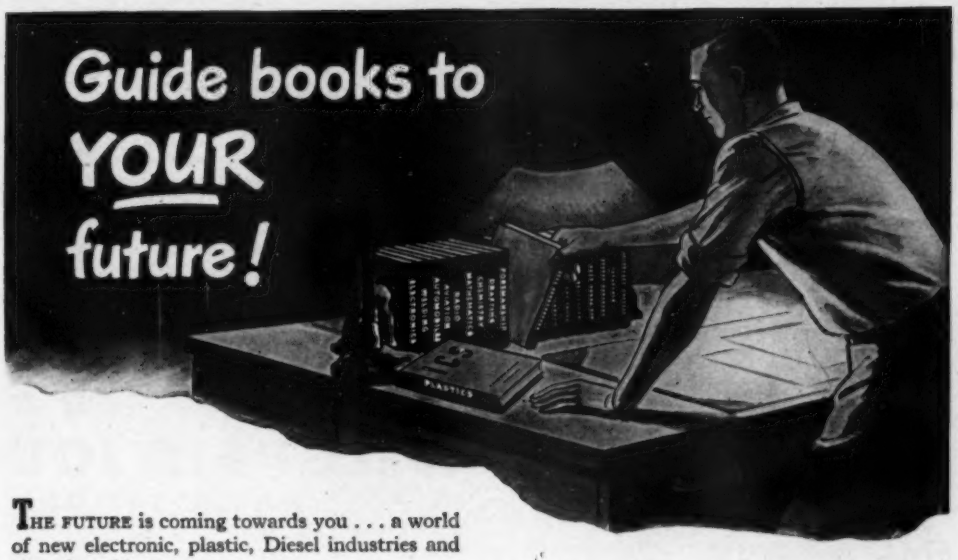

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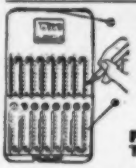

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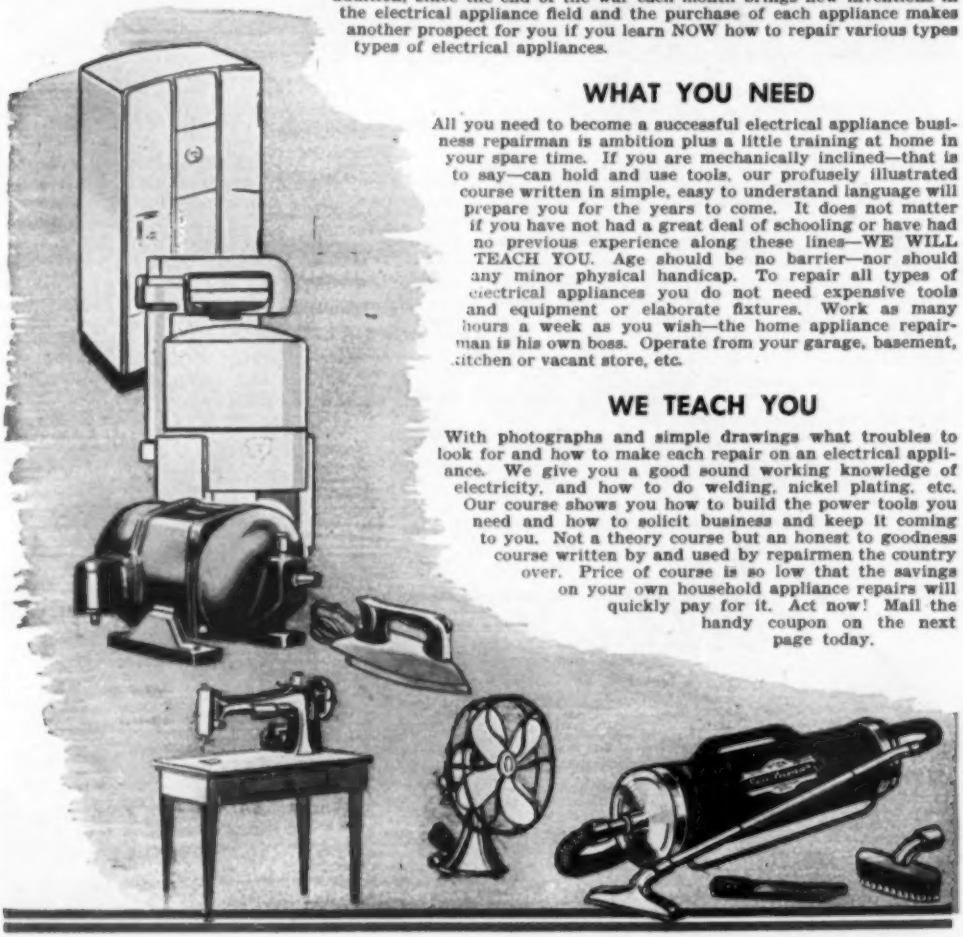

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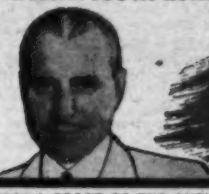

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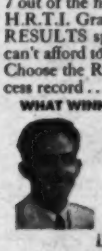

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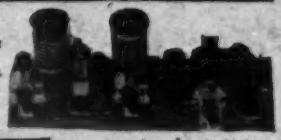

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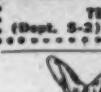

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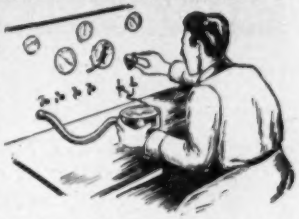

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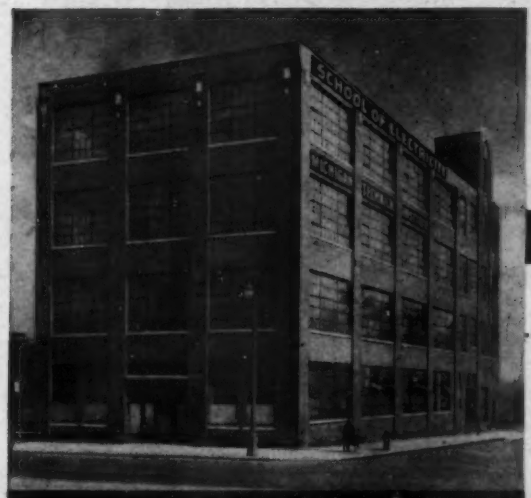

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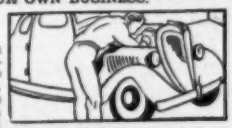

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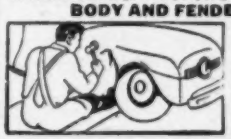

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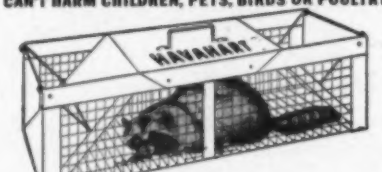

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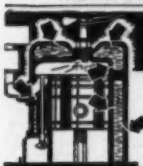

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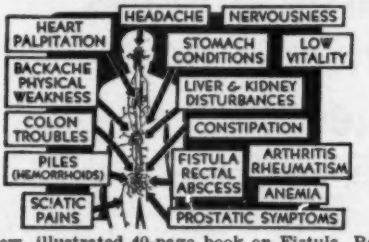
Fistula May Often Result From Piles

FREE BOOK—Gives Facts On Associated Ailments



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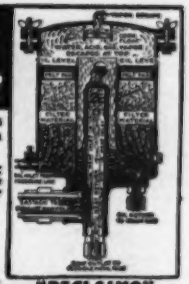

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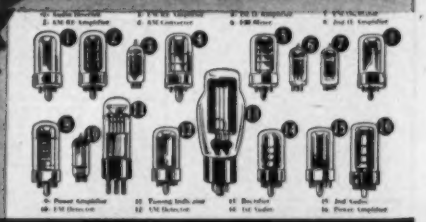

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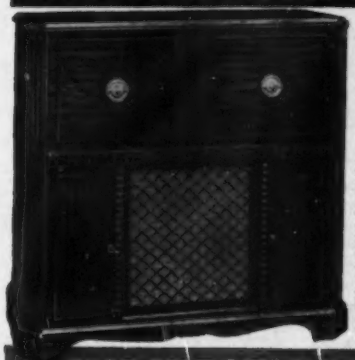

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Top quality hand microphone with control button in handle. Highly sensitive. Has rubber covered cord and tel. plug. Fine for use on home recorders, public address systems, etc. Brand new — perfect. Shp. wgt. 2 lbs. Stock No. 170. Each..... **$1.95**

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Of fine heavy khaki. Big roomy pockets with snap button fasteners. Fine for hunters, campers, boy scouts, etc., also for shop work in carrying small parts, etc. Material alone is worth this price.
11 Pocket Type No. 139. EACH **49c**
6 Pocket Type No. 138. Each **29c**

BAYONET BLADE

Fine forged steel. Ground but not polished. May be made into throwing or hunting knife or spear. Blade 6¾x⅞ inches, 11¾ inches overall. Will take and hold a fine edge. Shp. wgt. 1 lb.
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Combination 4 piece telescoping bait and fly casting rod. Screw locking reel seat. Cork grip. Snake guides. Extends to 9 feet, telescopes to 38 inches. Shp. wgt. 1 lb.
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Regulation two piece Army Mess Kits with folding handle. Used, but perfect. Weight 2 lbs. No. A116. Each **69c**

LEVEL WIND ANTI BACK LASH REEL

Highest quality with chrome plated frame: 3 piece take down design, 4x gears, bronzed bearings and jeweled spool caps. Spool diameter 1½ ins: pillar lengths 1¼ ins. Capacity 100 yard line. Onyx head ring. Shp. wgt. 1 lb.
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Reg. U.S. issue canteens. Plastic screw top chained to body. Slightly used but perfect. Wgt. 1 lb. No. 117—Metal. No. 118—Plastic.
Each..... **69c**

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Of fine white rayon fabrics 5 x 8 feet in diameter with split seam for directional dropping. Designed for dropping fragmentation bombs, emergency rations, etc. Each packed in a metal container. Weight 6 lbs.
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All metal. Folding handles. Wgt. 1 lb.
No. A120. Each..... **25c**

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Heavy canvas. Button fastener.
New No. 530. Each..... **69c**
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100% wool, regulation OD. Army blankets. Class B, perfect. Used but renovated for re-issue. Wgt. 5 lbs.
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For your car, boat, furniture, etc. Highly polished chrome finished strips with clinched edges for finish mounting to any surface. The 3 pound kit provides approx. 42 pieces in lengths from 4 inches to 3 feet and ¼ to ¾ inches wide.
Wgt. 4 lbs.
No. R-224-3 lb. Assort. only **$2.00**

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Of heavy canvas webbing. Adjustable. Eyeleted all around. Used but perfect. Wgt. 2 lbs.
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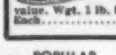

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CAMERAS—movie projectors — enlargers —free catalog. Cavalier Camera, 1822 Center, Pittsburgh 19, Pa.

BOOKLET: Packed with helpful hints and suggestions for making better pictures and deriving more from photography, included with kit of parts for building your own candid camera. $3.00 money back guaranty. Norton, Box 2185, Los Angeles 53, Calif.

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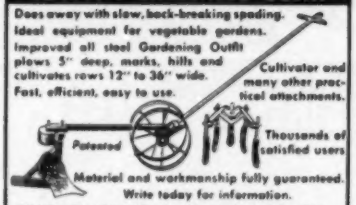

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3 Rotary files ¼ inch shank high speed
1 India oil stone 4 x ¾
1 Pr. nickel plated forceps
1 Pr. spring back pliers
1 Grinding wheel 6 ½ x ½
1 Grinding wheel 6 x 1¼ x 1
1 Grinding wheel 6 x ½ x 1¼
1 Grinding wheel 7 x ⅛ x 1¼
1 Grinding wheel 10 x ½ x 3
1 Cut off wheel 10 x .060 x ⅝
1 Cut off wheel 10 x ⅛ x 1½
1 Saucer wheel
1 Flaring cup—Cloth abrasives
100 Sanding strips up to 10 x 2
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POPULAR SCIENCE MONTHLY FEB. 1947

50-TON SQUEEZE

THE HYDRAULICALLY POWERED jaws of this pressure riveter, exerting a force of 50 tons, can put rivets in their place with a noiseless squeeze. Used to speed the assembly-line production of modern railway cars (see page 121), the riveter joins major units of a car's frame, shown in lower foreground.

Observer on deck of surface ship can use television to view deep-sea wonders, and to guide diving sphere containing pickup camera.

TELEVISION

It extends human vision beneath seas, into furnaces and throughout factories.

TELEVISION is adding overalls to its dress clothes. Its sleeves are rolled—it is ready to go to work!

To most of us, television has been a promise of armchair entertainment—a chance to have choice seats at boxing bouts, football games, news events and stage plays without budging from the budget or the living room. That phase of television is here, but television's future goes far beyond the mere prospects of animated quiz shows and soap operas you can see.

Television, like radio, is a versatile tool. A relatively small percentage of the radio waves that flash around the earth today carry music and comedy to our loudspeakers. Most of them have more important missions. Radio helps us go places and do business. Without it, large-scale scheduled air travel would be impossible, sea travel would be slowed, crime prevention hampered, news coverage cut down, and international business and diplomacy limited.

Television likewise means much more to us than an amusing accompaniment for radio's sound. Its workaday uses are even more dramatic than its role as an entertainer.

I found that out when I got a firsthand look into television's future at the large modern laboratories of the Radio Corporation of America at Princeton, N. J. There I put questions to Dr. Vladimir K. Zworykin, director of the laboratories' program of electronic research—one of the men who helped raise television from its flickering beginnings to its present status.

Getting Dr. Zworykin to talk about television was not a hard assignment. He thinks it, dreams it, lives it, and talks about it with parental love.

"Television," he explained, after he had shown me his laboratory, "is an extension of our sight. It gives us a simple means of getting eyewitness views of things happening in places too small, too distant, or far too dangerous for the average person to observe. Properly applied, television can show us many things that we have never seen before. It can open up whole new frontiers of research and knowledge.

"Undersea exploration is an excellent example. Few divers can descend more than

200 feet. Television, however, can put our eyes there without risk to our bodies. By installing a television camera in a thick-walled metal bathysphere, lowered from a survey ship, the deepest ocean floor can be explored safely and for hours at a time by skilled observers seated comfortably in front of a direct-wire television viewer on deck—or on dry land, for that matter, if the television signals from the camera are radio-relayed from ship to shore."

As Dr. Zworykin enlarged on his idea I realized that the construction of such a television bathysphere would present no great problems. It could be similar in design to the diving ball that Dr. William Beebe used in his undersea observations. With thicker walls to withstand greater pressures, it would otherwise be simpler, since a television camera, unlike a man, requires no oxygen and would be unaffected by the near-zero temperatures 600 feet under.

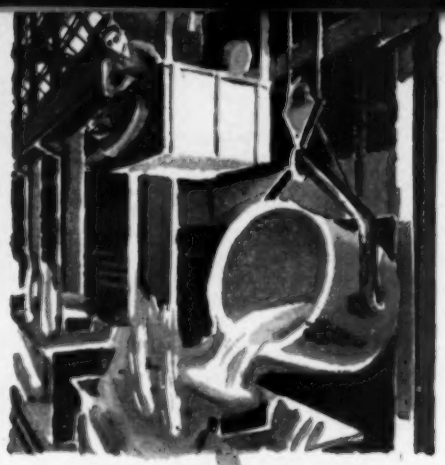
Since scenes have been televised from the dim light of a candle, illumination would not be difficult. The modern television camera using the new Image Orthicon tube, another Zworykin-guided development, is as sensitive to light as the human eye, so floodlights for underwater television exploration would have to be no brighter than those required for human observation. The bathysphere could be lowered by cable, while remotely controlled motors built into a supporting gimbal could turn and tilt its "eye" to scan the surroundings. The bathysphere could be used to aid under-water

on the JOB

By GEORGE H. WALTZ, Jr.

Dr. V. K. Zworykin, right, sketches plan of his "television bathysphere" for R. R. Macguire, PSM's art editor, left; George Waltz, and cover artist Ray Pioch, standing.

Welding jobs on automobile bodies may be inspected by television in the factory of tomorrow.



Hot metal pours into molds before one of the numerous "eyes" at key points throughout the plant.

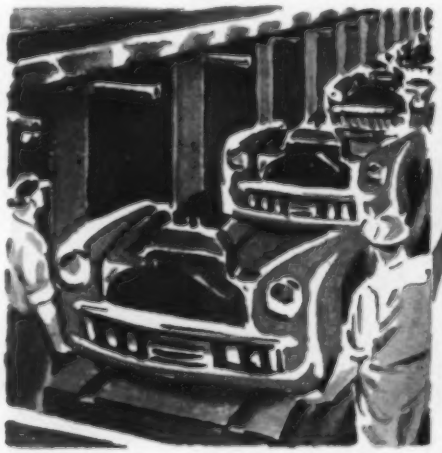
salvage, guide the placing of drilling gear for undersea oil wells, assist in submarine rescues, and, perhaps, even test the myth of lost Atlantis. The depths that could be plumbed would be limited only by the strength of the sphere's metal shell.

Similarly, according to Dr. Zworykin, television cameras can give us close-up views of what goes on within chemical reaction chambers, inside fiery furnaces and behind the thick lead walls that surround atomic-fission experiments. It provides us with a third eye that is unaffected by lethal fumes, heat or radiations.

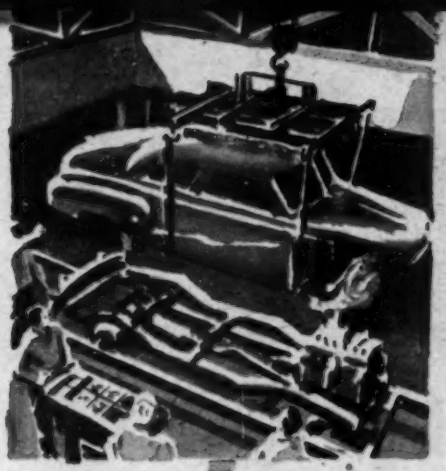
What actually goes on inside smelting furnaces and glass furnaces is still pretty much anybody's guess. The heat is so great that temperatures must be measured from a distance with optical pyrometers, and quick glimpses through jet-black goggles are the only observations possible. Any closer view would sear the flesh, blind the eyes.

Television cameras at strategic spots inside the furnaces could flash pictures of the fiery mass to a viewer in the office of the

From a central television booth, below, one man may co-ordinate all the activities of a great industrial plant. Image viewers enable him to watch every step in transforming raw materials into finished product.



Activities extending over more than 25 miles of production lines may be controlled from a central point.



Remote control matches the pace of merging assembly lines, as where body of a car meets chassis.

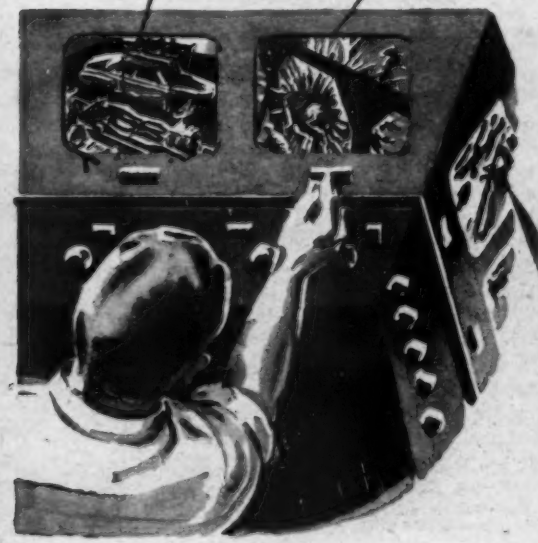
Viewers instantly detect fire or explosion, speeding alarms, emergency measures, and first aid to injured.

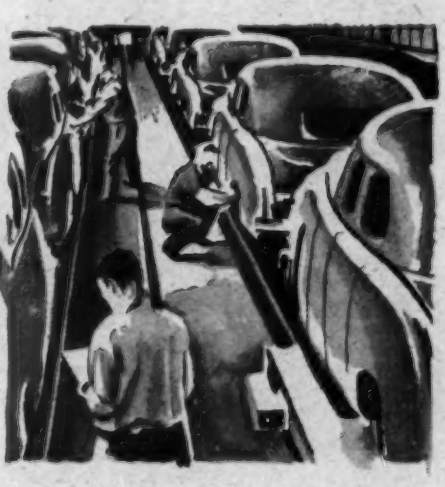
plant engineer. He could watch the process from beginning to end with no more bother than switching his viewer from one camera to another. He could literally "walk around" inside the furnace. The glow from the molten metal or glass would provide more than enough illumination, and liquid-cooled jackets would protect the cameras.

Dr. Zworykin also envisions television as a super-supervisor in the large factory of tomorrow. Television cameras set up in the various departments of a manufacturing plant would allow one man in a central viewing room to watch, control and safeguard the entire plant's activities. Rows of television viewers would show him exactly what was happening at nerve centers of the factory. His master control room would be an industrial equivalent of the CIC (Combat Intelligence Center) rooms that coordinated our fighting forces along the different fronts during the war. Such a system would speed production and safeguard life and property.

A similar setup on a smaller scale could

His telephoned orders regulate the tempo of each department so that all work smoothly together. Master switches at his fingertips permit him to stop machinery, close fire doors and sound alarms.





A final checkup, before the product leaves the factory, is double-checked by the television supervisor.

Only a few privileged spectators can look on from as close a point of vantage as this, while a famous surgeon performs a delicate operation. Medical students have had to watch from a distance.

be used to control the flow of automobile assembly lines. At present, it requires the services of a corps of men to supervise the 25 miles or more of subassembly and main assembly lines that snake their way through most big automobile plants. Television cameras set up at the feeder lines and along the length of the main assembly line and wired to viewers in the main supervisor's office could bring the entire problem under his eyes.

Television may well change our whole concept of educational techniques, Dr.

Reproduced upon auditorium screens, the television pictures of the operation would give every member of the audience a view as clear and detailed as that of the surgeon himself.

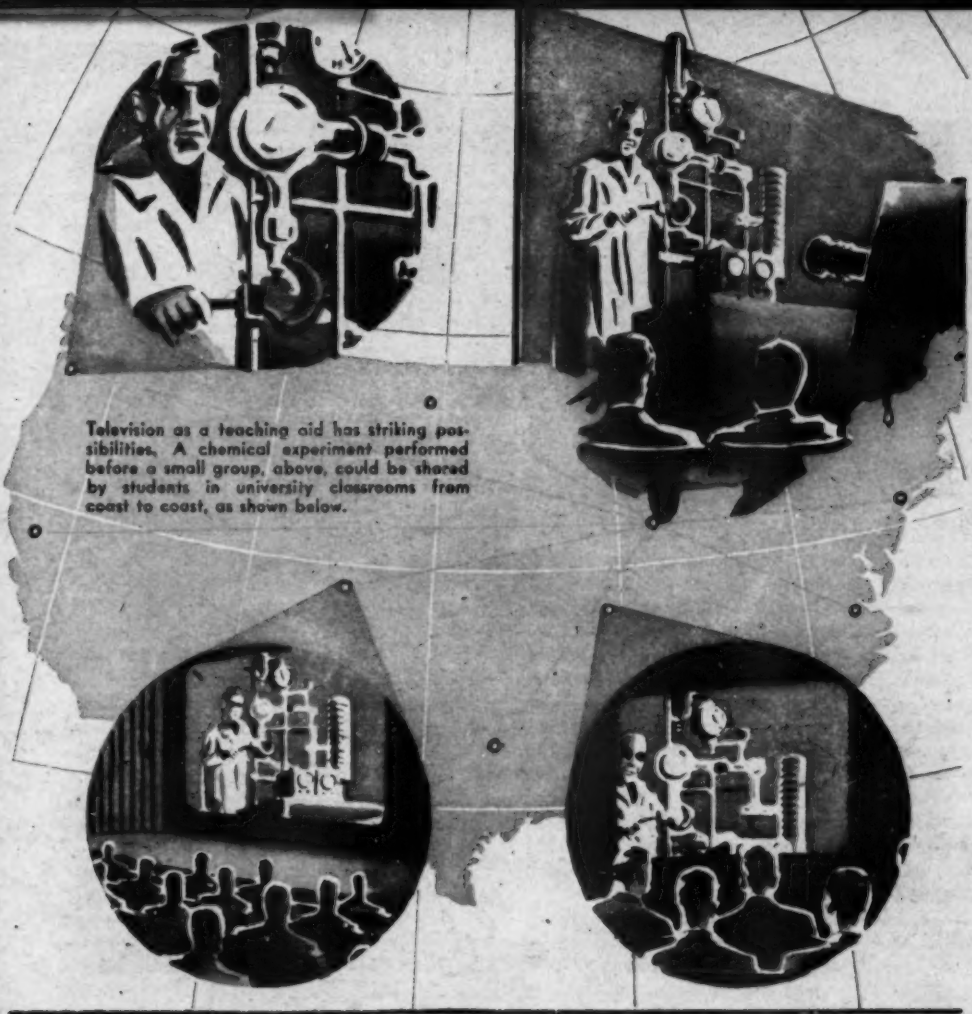
Zworykin believes. This is particularly true in medicine, where a student's view of an operation consists of what he can see from his seat high in the operating-room amphitheater. Television, however, can give him a surgeon's-eye view of the whole proceedings. A television camera mounted in the cluster of lights over the operating table and wired to screens in classrooms would not only give each student a close-up of even the most delicate operation but would allow hundreds of students, instead of a few, to watch the demonstration. If put on the air, an operation could be witnessed by students in medical schools all over the

Suspended directly above an operating table, a television transmitter would be in an ideal position for observation, picking up and transmitting what takes place beneath it without missing the smallest detail.

country wherever television was available.

Long-distance diagnosis is another medical possibility. With the aid of television, a doctor and his patient could take full advantage of the knowledge and skill of a specialist a thousand miles away. Public health doctors could make actual television visits to health clinics in outlying districts. Special health lectures could be delivered simultaneously to widely scattered groups.

There is no reason why students some day will not get first-hand televised looks at the moon and stars through the giant Palomar telescope, watch important experiments in progress at the world's great research centers, sit in on the actual proceedings at international conferences, or "attend" any of the firsts in science, exploration and the arts. Famous lecturers and educators could be



Television as a teaching aid has striking possibilities. A chemical experiment performed before a small group, above, could be shared by students in university classrooms from coast to coast, as shown below.

Reporter in field with television, below, covers news event. At right, editor in a central studio receives pickups of many reporters and decides which to broadcast.

Television cameras with cooling jackets can disclose what happens in smelters, glass furnaces and other places where terrific heat precludes a direct view.

seen and heard simultaneously in schools all over the country.

Television as a teaching aid was dramatically demonstrated in New York City during the war when first aid and fire-bomb-fighting methods were explained to the city's volunteer air-raid wardens via the television camera. Viewers set up at air-raid posts throughout the city made it possible for a single group of civilian-defense experts to demonstrate air-raid procedures to more wardens than ever could have been jammed into the city's largest auditorium. And what is more to the point, every warden had a close-up of the demonstration.

I asked Dr. Zworykin if he thought it would be possible to equip news reporters with lightweight television cameras that would allow them to broadcast on-the-spot views of accidents, fires, train wrecks and similar news events. As an answer he showed me the compact, lightweight television camera that has been developed for use in a guided rocket. Weighing only 34 pounds, and no larger than a suitcase, it may well be the forerunner of the newscaster's "walkie lookie." It would have to be changed only slightly. Its compact transmitter and power supply, stowed in the reporter's car, would transmit the scene being televised to a main broadcasting station. There a picture editor, seated before a bank of viewers showing the individual pick-ups from perhaps a dozen reporters on their beats, could select the events he desired and rebroadcast them to the station's television public.

COVER. Undersea exploration with a pair of television bathyspheres. Painting by Ray Pioch.

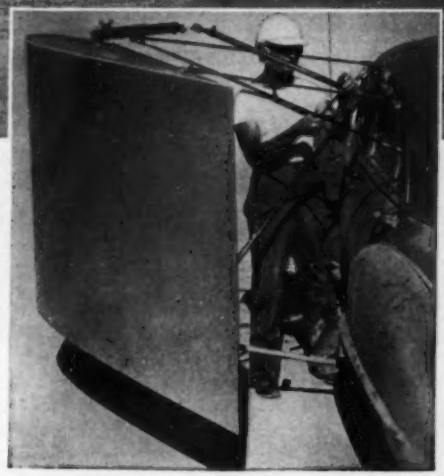
Several department stores are experimenting with direct-wire television as a means of displaying merchandise to customers. Fashion shows, displays and special skits to demonstrate kitchen and garden equipment are televised and piped to viewers placed in the store's windows and at eye-catching spots around the store. In a sales test run by one large Eastern department store a poll of the customers showed that nine out of 10 felt television was an aid to their shopping.

Television billboards are the latest advertising wrinkle. The plan, conceived by a Boston, Mass., outdoor advertising firm, calls for a network of large outdoor screens to display television sales programs broadcast by a central station. Set up on roof tops and on the sides of buildings, the television billboards will offer a variety of entertainment interspersed with commercials.

A New York bank is considering installing a direct-wire television system to speed up and simplify the identification of customers. A viewer at each teller's counter connected to a camera at the identification-card files will allow him to verify signatures and bank balances without leaving his window. A similar network for the nation's police forces would speed identification of criminals by photos and fingerprints.

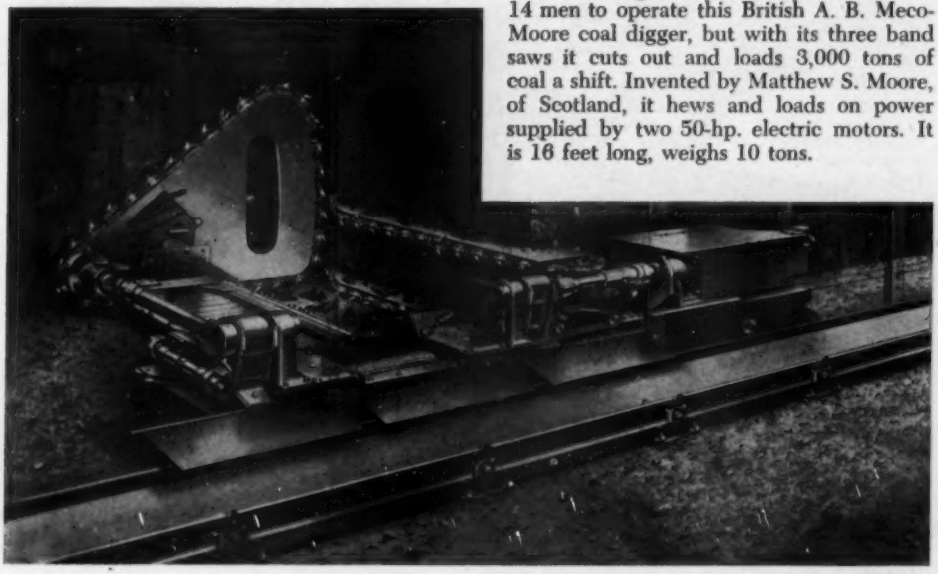
New developments still in the laboratory—such things as three-dimensional and full-color pictures—will extend television uses even further, Dr. Zworykin believes. Full-color television alone, for example, will greatly simplify the accurate matching of colors in the paint, dye and textile industries.

In the meantime, television as we know it today can go far to help industry solve its problems. END

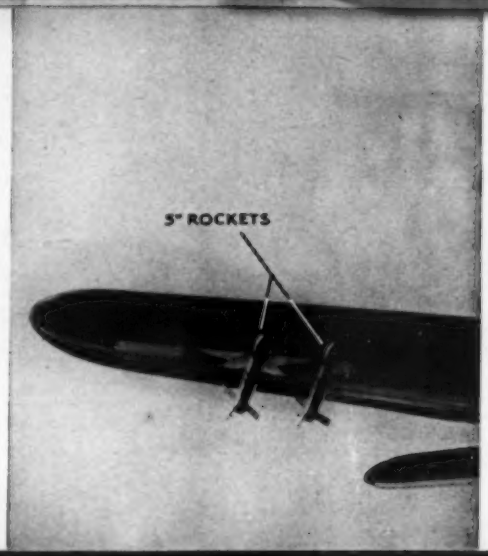


Auto Sprouts a Wing. It's not a style for the everyday motorist--but it's a style that will do the everyday motorist a lot of good. The car above with the fin sticking out at its side is testing United States Rubber Co. tires on the bed of a dry lake near Lancaster, Calif. As can be seen at the left, the fin is a section of an airplane wing. It exerts inward thrust to offset centrifugal force on curves and allows the car to rip around a five-mile circular track at 90 m.p.h. as if it were on a straightaway.

Robot Digs British Coal. It takes 14 men to operate this British A. B. Meco-Moore coal digger, but with its three band saws it cuts out and loads 3,000 tons of coal a shift. Invented by Matthew S. Moore, of Scotland, it hews and loads on power supplied by two 50-hp. electric motors. It is 16 feet long, weighs 10 tons.



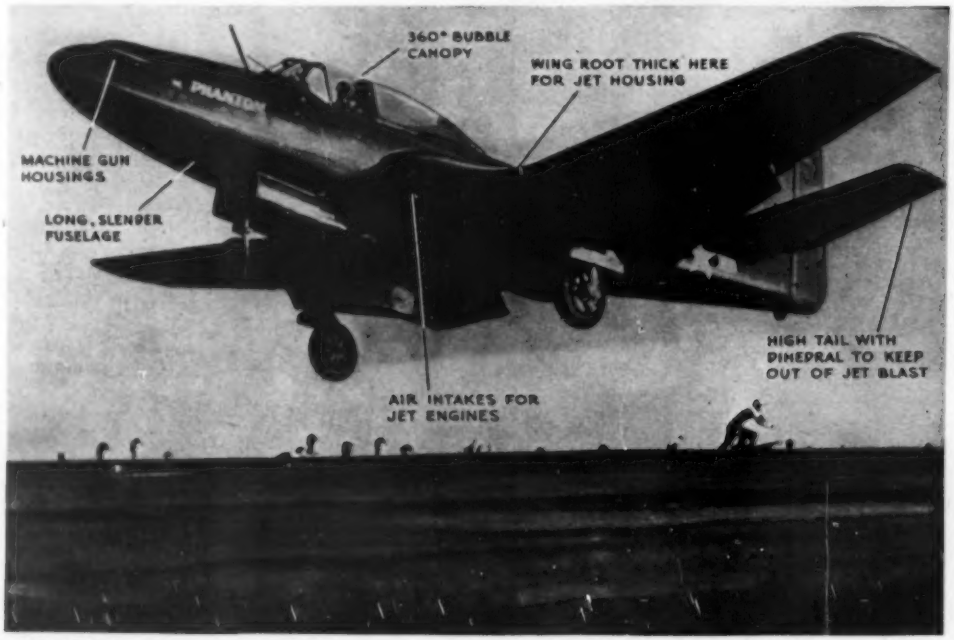
EVIDENCE that the Navy is passing up no bets in the jet-propelled aircraft field was presented recently when two new jet fighters—the XFJ-1 and the XF6U-1—the fastest planes in the Navy's sky armada, were unveiled. This pair of jets, the Navy says, are peers of the Army's Lockheed P-80 Shooting Star and Republic P-84 Thunderjet. Furthermore, the Navy has announced the XP4M-1, a jet-plus-propeller, land-based patrol plane, built by The Glenn L. Martin Co. A long-range, high-speed craft, it recently made its first test flight.

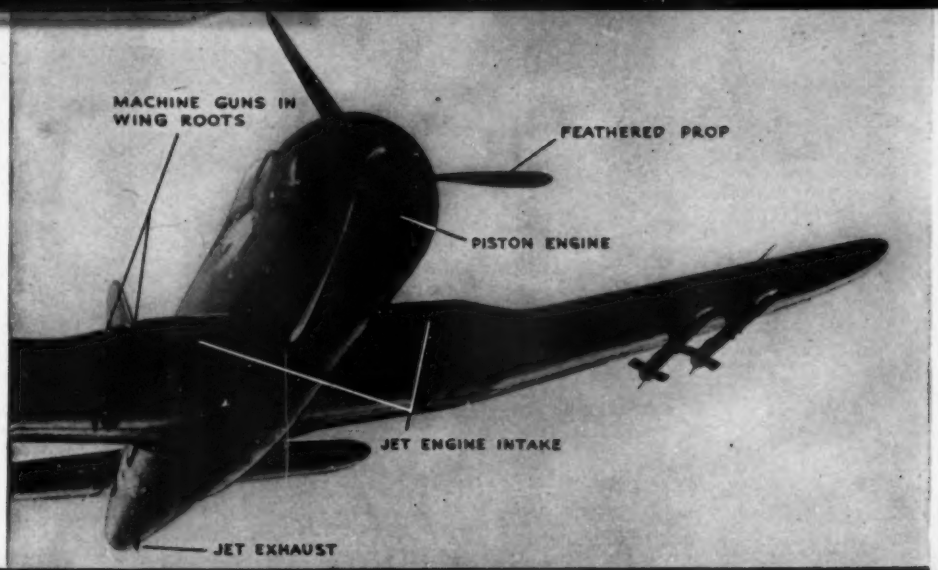


First use of jet propulsion by the Navy was in this Ryan FR-1 Fireball fighter, right, which combines a jet engine and a piston-type power plant.

JETS *Go to Sea*

After Pearl Harbor, experts began work on plans for the Phantom, below, first all-jet Navy plane. Today's faster Navy jets are all follow-ups of the pioneer Phantom, which was built by McDonnell Aircraft.

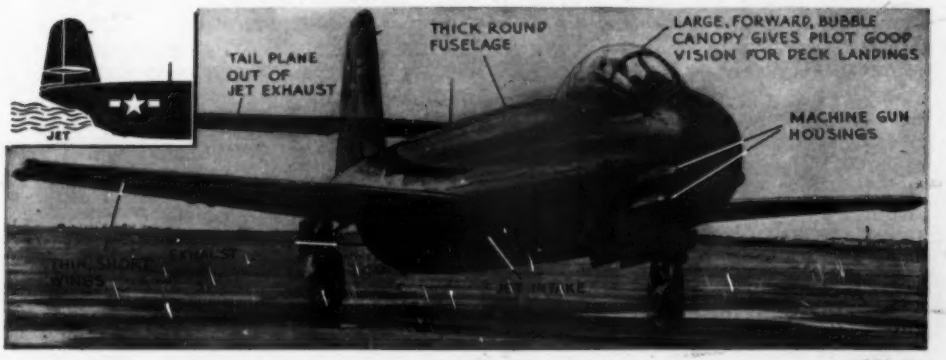




Navy steps up speeds in its air armada.

Built by North American, the XFJ-1, above, has a General Electric jet engine that gives it a speed well over 500 m.p.h. When carrier-based, the fighter is launched by a catapult. Wing span is 38 feet; wing-tip fuel tanks can be jettisoned.

In the XFJ-1's speed class, the Chance Vought XF6U-1, below, is powered by a Westinghouse jet unit. With a wing span of 30 feet, the fighter is made of metalite, which sandwiches a balsa wood core between two thin aluminum-alloy sheets.



AIR LINES Warm Up ARCTIC Short Cut

By DEVON FRANCIS

THE world will take a hitch in its belt in the next few months. Passengers on commercial air lines, at long last, will be able to fly across the top of the world—*the shortest distance between the world's most populated places.* One such route has been approved. Others will be.

For the person who buys a ticket to Stockholm or Tokyo, Arctic and sub-Arctic flying will be pioneering in the sense that riding the air lanes in Ford trimotors 20 years ago was pioneering. In the winter the Arctic is the womb of storms. Pilots say that sometimes it's like flying in a bowl of milk—the visibility is that bad. Cabins will have to be heated to withstand temperatures skidding to −50° F. Good hotels will have to be built a thousand miles from nowhere to accommodate passengers if the weather closes down. (And they probably will have to be air conditioned in the summertime; at some points in the Arctic the temperatures climb as high as 100° in the shade!)

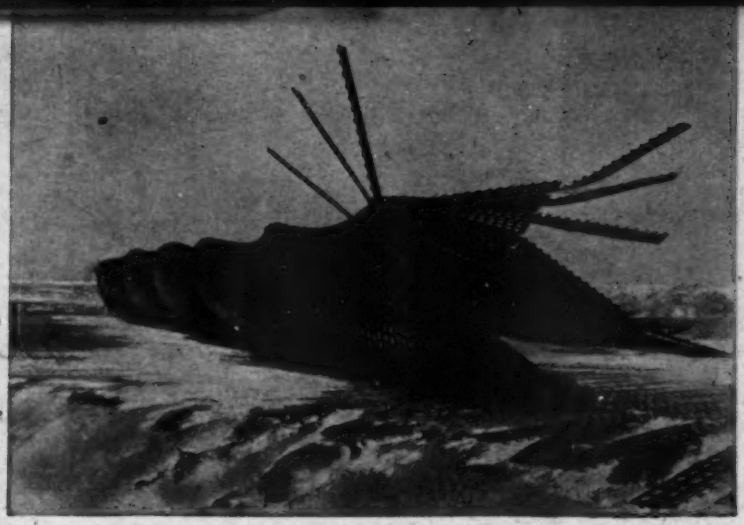
All this doesn't mean that flying in the Arctic and near-by regions will call for special daring on the part of the passenger. Neither will he have to rush off to Abercrombie's for a parka or an explorer's sleeping bag.

For the air lines themselves, flying Arctic routes will be something less than pioneering. As contract carriers for the government, they flew over the top of the world during the war. So did the Army and Navy.

Wartime fliers of the far north learned to combat extraordinarily heavy ice formations in flight, windblown "horizontal snows," violent Aleutian storms called "williwaws," Alaskan steam fog, and "sea smoke" that blotted out a view of the wing tips even in a 60-mile gale.

But the routes were established. The Army Air Forces Air Transport Command did much of the work.

Starting in 1941 the ATC network of bases on the European leg expanded from



Eloquent evidence of the force of the Aleutian winds is the twisted, 3,500-square-foot, eight-ton steel runway matting at left. A gale from the Bering Sea whisked it up from where it had been frozen into the rocklike sub-Arctic ground at an Army Air Forces base on Amachitka Island and tortured it into its grotesque shape.

the solitary base at Gander Lake, Newfoundland, to more than 20 new airdromes and establishments for communications, weather observation, aircraft servicing, and housing of personnel in Newfoundland, Labrador, Baffinland, Greenland and Iceland. Some of these bases have been made available to the commercial lines.

On the route to Asia, the ATC pioneered the 24-hour Seattle-to-Tokyo run, over which C-54 Skymasters are trail-blazing by carrying mail and cargo on the new 4,880-mile Great Circle course, via Adak in the Aleutians. Almost 3,000 miles and 16 hours' flying time are cut from the old dog-leg route across the Pacific through Hawaii and Guam. Northwest Airlines has been authorized by the Civil Aeronautics Board to establish passenger service, but no travelers will be carried until air crews become thoroughly familiar with the Aleutian weather and terrain.

Arctic commercial air lines require accommodations and expanded facilities that were not absolutely essential at the time ATC was carrying high-priority passengers and cargoes to Europe and Asia to expedite our war effort. Then it was a case of overcoming the U-boat menace and getting planes and people and material to the battle zones as quickly as possible. Today it is a case of safety, comfort, speed and cost, in that order.

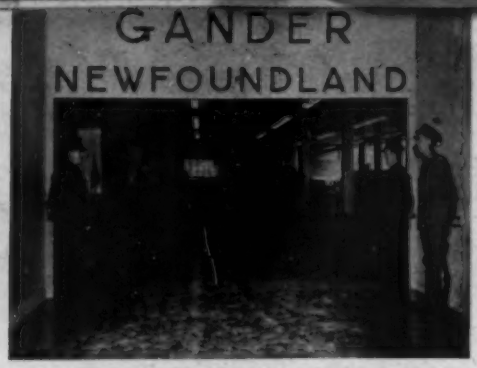
Air travelers who fly these routes will find a great airport at Goose Bay, Labrador, and will see how Greenland's BW-1 base (short for the airdrome's code name, "Bluie West 1") practically snuggles between the mountains and the foot of a great glacier.

Some of the facilities are marvels of engineering. Sites for the airdromes were scouted from the air, with the reconnaissance parties looking for river-bed locations between mountain ranges, because these usually had an eroded gravel base. But such preferable sites could not always be found. Goose Bay, for example, was built on a huge sand delta. Harmon Field, located at Stephenville on Newfoundland's west coast, was put in shape only after muck and peat 20 feet deep were excavated and replaced by a hard fill.

Arctic travelers will have the benefit of delicate weather forecasting. The men of the AAF 8th Weather wing originally set up and manned the network of Arctic stations. In addition to forecasters, who predict conditions in advance of flights, each station required a staff of weather observers and "rawinsonde" technicians (PSM, Jan. '46, p. 71), who measured and recorded atmospheric conditions in their respective regions. Weather-reconnaissance planes, carrying special instruments and observers, made long flights and brought back data that was fitted into one big weather picture of existing and predicted conditions.

One of the world's most extensive hotel systems was operated by ATC, and the now-famous "Hotels De Gink" had "all the comforts of home." Every base had its Hotel De Gink for the flood of passenger traffic that developed during the war. Only a few of these establishments would be fancy enough for paying passengers in peacetime, however, and the commercial lines are planning their own passenger accommodations. American Overseas, for one, has com-

For warming up clipper engines in Alaska, Pan American uses 262-pound "fire pots," which are placed under the tarp-covered power plants.



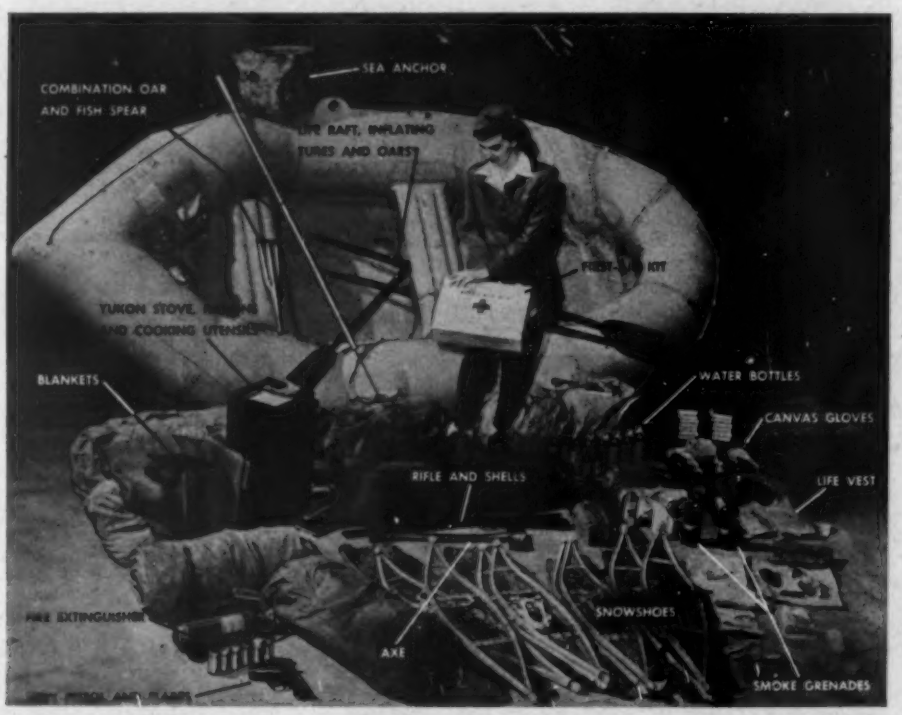
Once a military beehive, Gander Field, Newfoundland, is now a commercial field with accommodations including lounge, restaurant and cocktail bar.

pleted plans for a $250,000 hotel at Gander Field, Newfoundland.

Air travelers to the sub-Arctic area will see buildings arranged in unusual patterns, as well as houses, hangars and other buildings built on heavy pile foundations. Frozen ground is not the firm foundation its hardness would indicate, and earth that is underlain by permafrost (PSM, Nov. '46, p. 126) can heave and settle to such a degree that houses and buildings quickly collapse.

Three-fourths of the earth's land and nine-tenths of its population are located above the equator. Moreover, the capitals and trade centers of the most important powers are north of the 37th parallel.

Commerce and military strategy must necessarily be concerned with the location of these population centers. And the routes that connect the United States most directly with them are over the Arctic and sub-Arctic regions. END



Stewardess checks 286 pounds of emergency equipment carried by Pan American on all Alaskan flights.

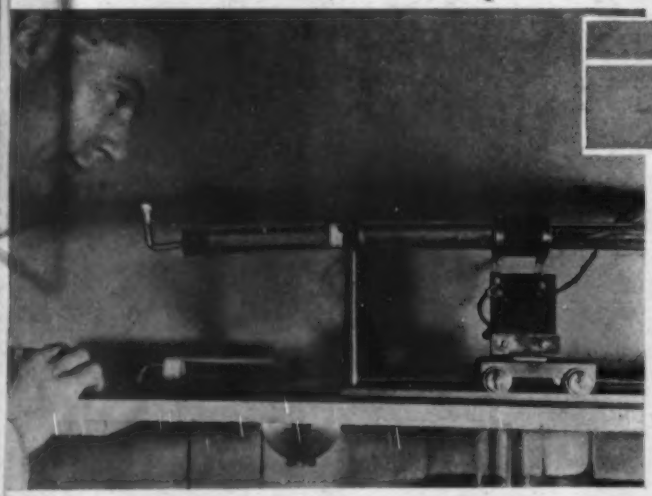
Two-Minute Car Washer. When a car emerges, shiny and clean, from this tunnel of tubes, it has spent no more time in getting a bath than it would in getting its gas tank filled. Air from the pipes evaporates all moisture after the car has passed through a stall (extreme right) where it had a once-over with soft, water-flushed brushes. Commerce Pattern Foundry and Machine Co. manufactures the automatic washer.

Plane Tire Made with Wire. By using steel wire cord under the tread, it is possible to make airplane tires smaller, yet able to carry greater loads, according to the U. S. Rubber Co. An experimental tire is pictured below with a coil of the steel cord.

Bazooka Turns Pitcher. Using the tube of a bazooka he carried during the war, Pete Wald, a New York optometrist, devised the mechanical baseball pitcher shown below. The tube carries the balls to a motor-driven throwing arm.

Camera Shoots an Engine's Knock. Taking 200,000 photographs a second, the ultrahigh-speed camera above is used by the National Committee for Aeronautics to study knocks in spark-ignition engines. The five frames at the right are photos of fuel exploding in a cylinder. The two arrows in the second picture from the bottom indicate the beginning of a knock.

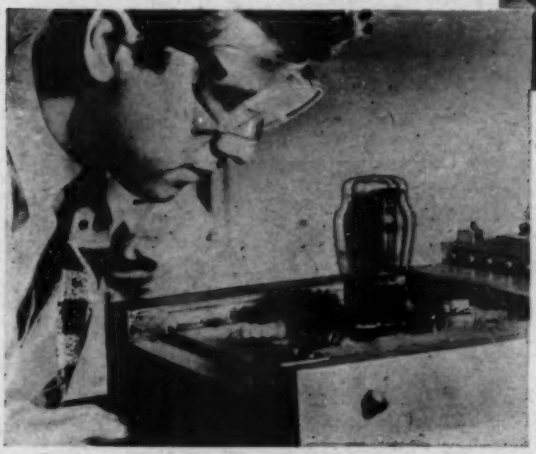
MARCH OF SCIENCE



Tube Herds Germs. Dubbed the "railway engine," a tube (left) at Smithdown Hospital, in Liverpool, England, is filled with sawdust infected with malaria germs. To corral the parasites for study, an electrically heated, mobile coil fits around the tube and moving from right to left, drives the germs before it to the end, which is free of sawdust.

Box Tortures Plastic. Under temperatures from –50° to 200° F., Westinghouse tests Micarta plastic in the box at right. An engineer measures one of two pieces preparatory to subjecting them to a strain test in which they will be vibrated 15 times a second for three months.

Vibrator Tests Tubes. When General Electric wants to try out electronic tubes for home and aircraft radio receiving sets, it gives them a terrific shaking up on the vibrator below. The machine jerks the tubes back and forth 25 times a second for 100 hours—9,000,000 shakes. Blurred outline of the tube in the picture indicates the rate at which it is vibrating.



RADIO'S "DARKROOM." Because its walls are lined with exite fins and its floor is covered with a steel grating that rests on rubber pads, an echo hasn't got a chance in the "free-field" sound room shown below. RCA uses the three-story chamber to study acoustics. A microphone is concealed in the mouth of the dummy head, and during experiments it simulates an announcer talking into another microphone, being adjusted in front of it.

Movie Shows A-BOMB'S BIRTH

1. Scene beneath Chicago stadium, where first nuclear chain reaction occurred on Dec. 2, 1942, is shown like this in M-G-M's *The Beginning or the End*.

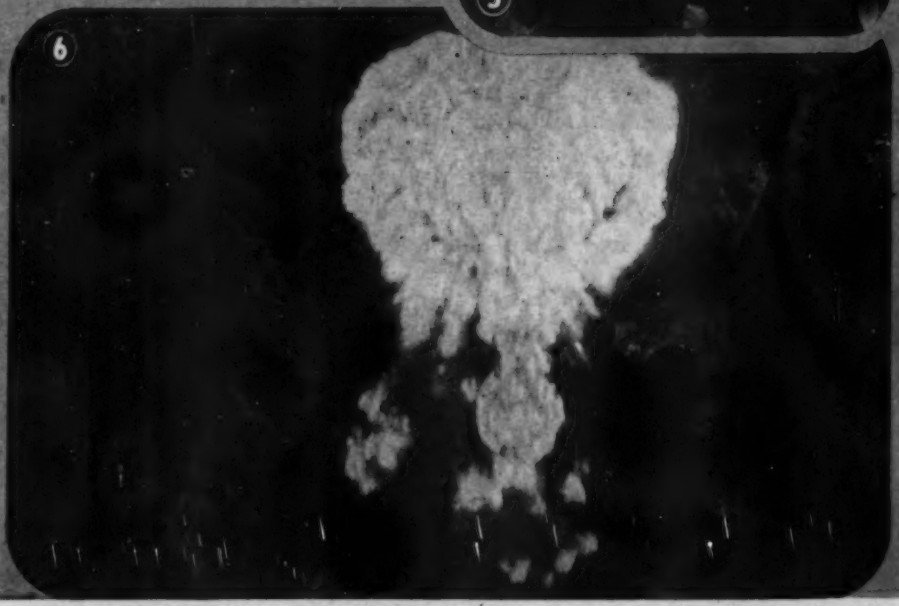
2. Actor, cast as Dr. J. Robert Oppenheimer, receives first uranium 235 refined at Oak Ridge from Army courier at Los Alamos, N. M., laboratory, near site of the first explosion of the A-bomb.

3. Scientists are depicted removing eye shields at desert observation post as glare from first atomic blast fades in the early dawn of July 16, 1945.

4. Crew of the B-29 Enola Gay is pictured being told what its job is and what could happen, shortly after the bomb was loaded for ride to Hiroshima.

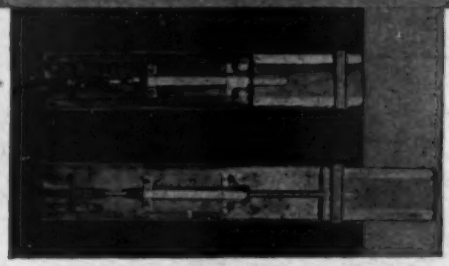
5. In this shot, an Army scientist gives a young officer in mufti a chalk-talk on what happens when parts of atoms knock each other around.

6. Hiroshima explosion was recreated in miniature for the movie. Manhattan project scientists helped check all scenes for authenticity.



JACK OF ALL TRADES. L-13, lowest Army liaison plane, takes off in 230 feet and lands in 227 feet at 43½ m.p.h. It can be used for observation, artillery spotting, ambulance service, etc.

L-13 FOLDS ITS WINGS. When towed on the ground, L-13's wings can be folded and its landing gear turned inward. In the air it can be towed, gliderlike, then released under its own power.



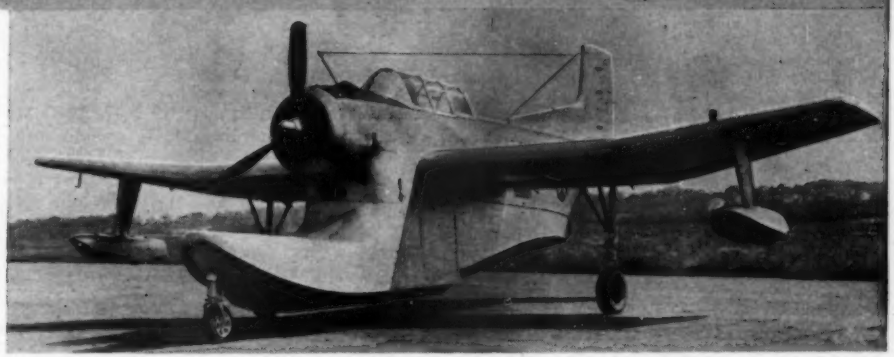
AILERON MECHANISM. Interior view of mechanism (above) on novel wing-tip aileron for a Fairchild pilotless aircraft shows aileron retracted (at top) and extended (at bottom).

"SKY HOOK" SPEEDS LOADING. Among many innovations for handling of cargo on the new Boeing Stratofreighter is a monorail power hoist (below) that handles 2½ tons at a time.

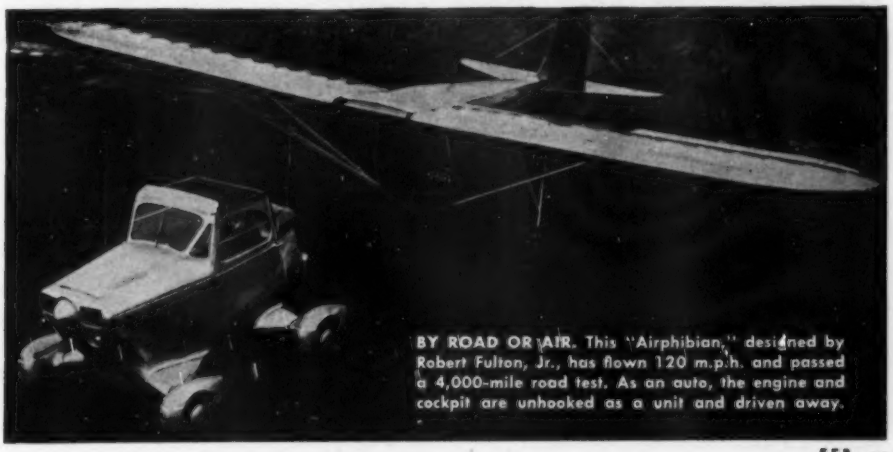
SIGHT AIDS LANDINGS. With a new landing sight, above, a pilot has only to set three dials—for glide speed, load and wind. The sight tells him when to cut power and where plane will land.

WHAT'S NEW in AVIATION

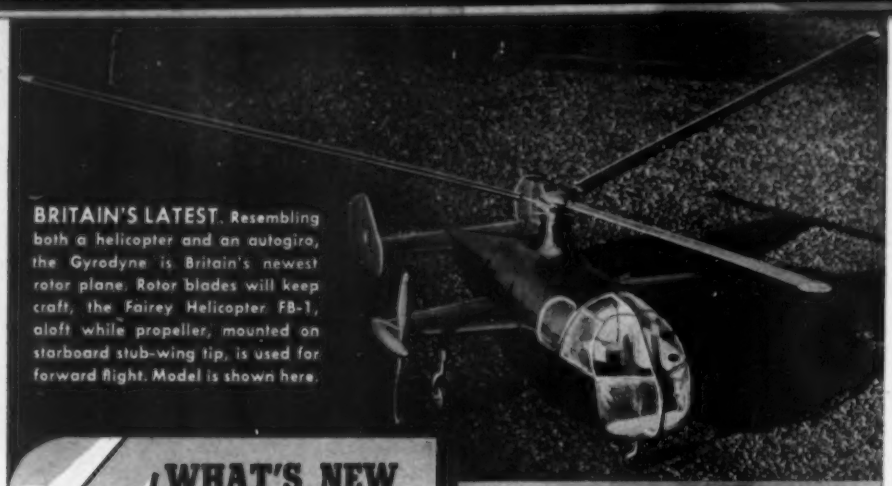
P-51 GETS A BOOST. When the Army recently experimented on a Mustang fighter (above), it installed two ram-jet engines on its wing tips. The jets don't start working until the P-51 hits 350 m.p.h.



RESCUE PLANE. The amphibian XJL-1 (above) was built by Columbia Aircraft for Navy search and rescue work. It has a 1,435-hp. engine and jet assistance for take-offs. Top speed: 200 m.p.h.



BY ROAD OR AIR. This "Airphibian," designed by Robert Fulton, Jr., has flown 120 m.p.h. and passed a 4,000-mile road test. As an auto, the engine and cockpit are unhooked as a unit and driven away.



BRITAIN'S LATEST. Resembling both a helicopter and an autogiro, the Gyrodyne is Britain's newest rotor plane. Rotor blades will keep craft, the Fairey Helicopter FB-1, aloft while propeller, mounted on starboard stub-wing tip, is used for forward flight. Model is shown here.

WHAT'S NEW in AVIATION

JET LIFTS GERMAN GYRO. Jet exhaust piped to the rotor tips is used by the WNF-342-V4, below, to climb, descend or hover. A small conventional engine at the rear of the fuselage powers a pusher propeller to provide a slipstream to improve directional control. It gives a 25-m.p.h. forward speed when tail elevators are tipped. AAF hopes to increase speed of the German-built craft by adding another pusher propeller.

BIGGER BENDIX CARRIES FOUR. The helicopter on the ground, above, is the new four-place Bendix "J." It has a 450-hp. Pratt & Whitney engine, and two main rotors that turn in opposite directions. Helicopter aloft is the one-place Bendix "K."

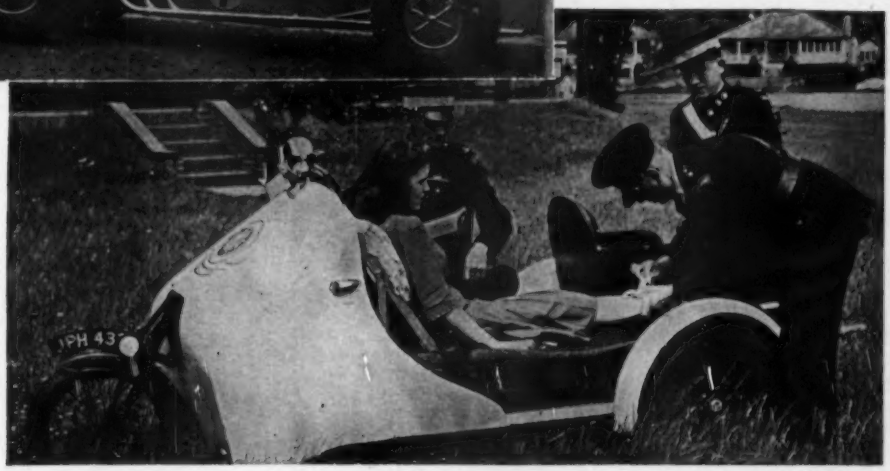
GLIDER NEEDS NO WINGS. The G-E Gyro-Glider at right has neither motor nor wings. As a jeep tows it to provide launching speed, the pilot is grasping the overhead controls that change pitch of rotor blades. The Gyro-Glider can lift about 300 pounds in addition to its own weight and is able to land in very small areas. General Electric built it.

It's Easy on Gas. Postwar Italy has produced the miniature, three-wheel (one in front) truck at left. It is a ton-and-a-half job and is said to get about 30 miles to the gallon of gasoline. Its engine has a displacement of 750 cubic centimeters. The truck was shown in Milan.

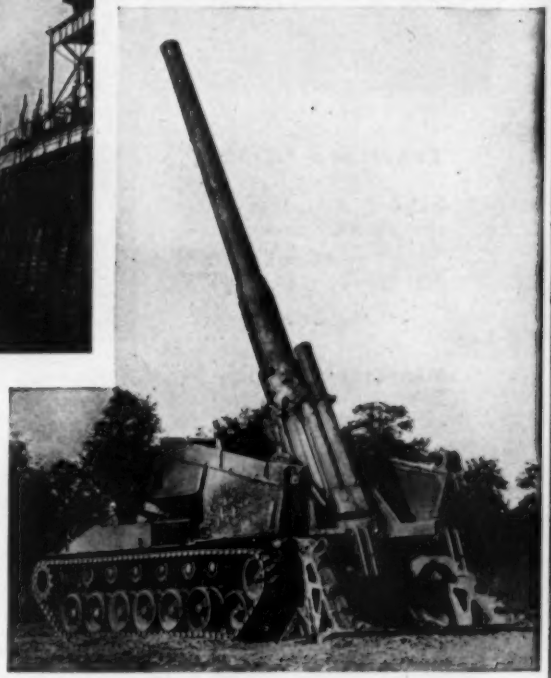
Truck is a "Trike." It's a tricycle—but not a toy. Although it is even smaller than the one shown above, the Italian vehicle at right also is able to carry up to a ton and a half.

Electricity Runs Model Racer. Roger Brown, of Meriden, England, sits in his electric model of a Grand Prix racing car, below. Built by his dad, an engineer with Nuffields, British car manufacturers, it is five feet six inches long.

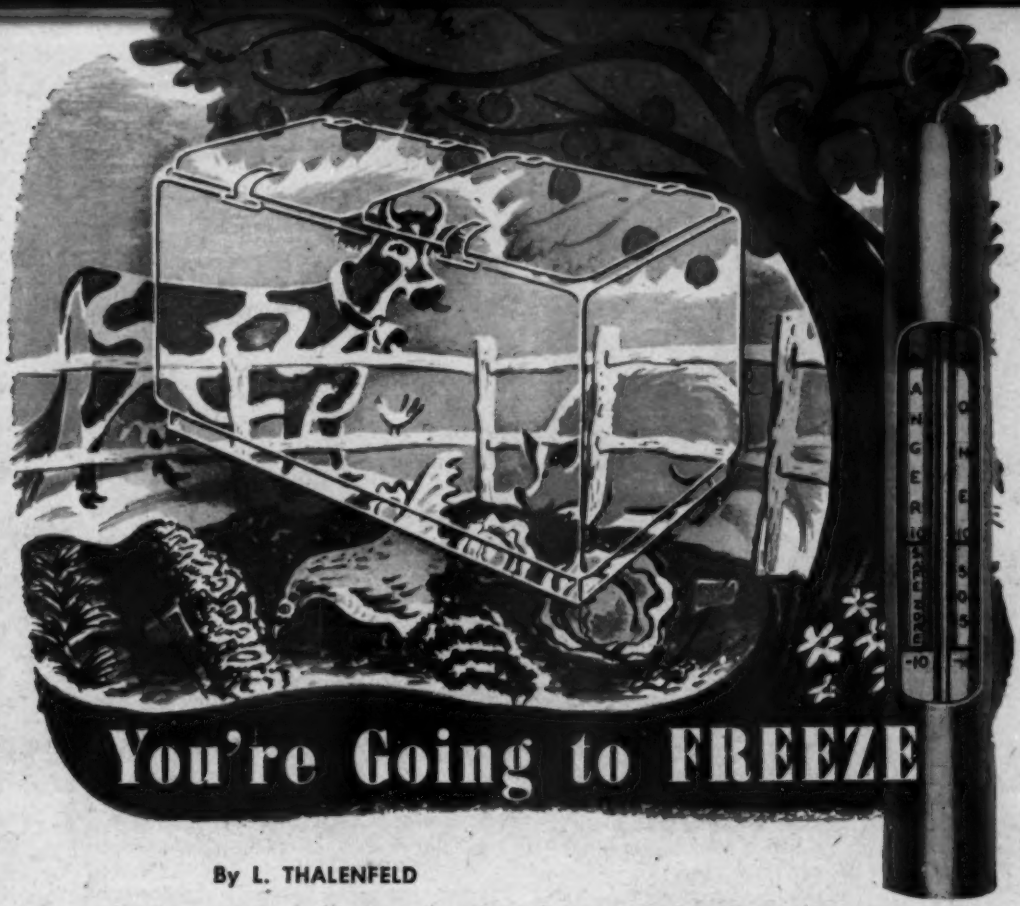
Byway Ambulance. Accidents on river paths near Runnymede, England, keep the emergency motorcycle ambulance below popping. The open vehicle was converted from a St. John motorbike.



Mud Slinger. In action, the Standard Dredging Company's 110-foot suction dredge, shown at left without its cutters, can scoop out a 55-foot-deep river's bottom and deposit it on the bank at the rate of 2,500 cubic yards an hour. It is working on the Atchafalaya river channel.



Tank Totes Big Guns. A new 63-ton, tank-type battlewagon, developed by Chrysler for the U. S. Army, mounts either an eight-inch rifle (right) or a 10-inch howitzer (below), and can be set up for action in five minutes. A spade tail is sunk into the ground to buck recoil. The rifle fires a 240-pound shell 27 miles, the howitzer a 360-pound missile 16 miles. The rifle's barrel is 35 feet nine inches long; the howitzer's is 27 feet seven inches.



You're Going to FREEZE

By L. THALENFELD

WHEN Clarence Birdseye was a fur trader in Labrador he tossed a frozen fish back into the water. Astounded, he watched as it revived and swam away. This gave him the idea of quick-freezing food to preserve it—an idea that has grown into an industry that expects to change the home life of 3,000,000 families every year.

Already, 800,000,000 lb. of frozen food are being sold annually—enough to supply the people of the State of Washington with fruits, vegetables and meats for an entire year. And this is only the beginning. Because food can be frozen in a third the time and with half the effort required for canning, more and more food will be preserved by freezing from now on. Freezers will soon be as commonplace as refrigerators.

A home freezer, in fact, is just an overgrown electric refrigerator. Both have a compressor driven by an electric motor, and an evaporator with coils. In automatic refrigeration, the refrigerant, generally Freon 12, is compressed and sent through the evaporator coils in the ice-cube compartment. The gas expands in the coils, absorbs the heat inside the box, and lowers the evaporator's temperature to 20° F. Food stored in a refrigerator keeps fresh for about a week at 40° F., the temperature normally maintained in the food compartment.

Some refrigerator manufacturers are producing freezers and using the same compressor for both. As a freezer's insulation is much thicker, the frigid air gets less of a chance to escape, and the freezer "coasts" longer than a refrigerator.

The cost of operating a freezer is about equal to that of a refrigerator. A farmer with an 18-cubic-foot freezer—about three times larger than the average household refrigerator—reported that his electric bill had not increased more than $2 a month.

There is talk of cutting electric bills when Freon 22, a brother of Freon 12, appears. Freon 22, with a boiling point of −41° F., 20 degrees below that of Freon 12, will save money by freezing food faster.

Anyone buying a freezer today has more than 300 brands to choose from, a different

The Kelvinator freezer features a corrosionproof liner and coils attached to all four walls of liner.

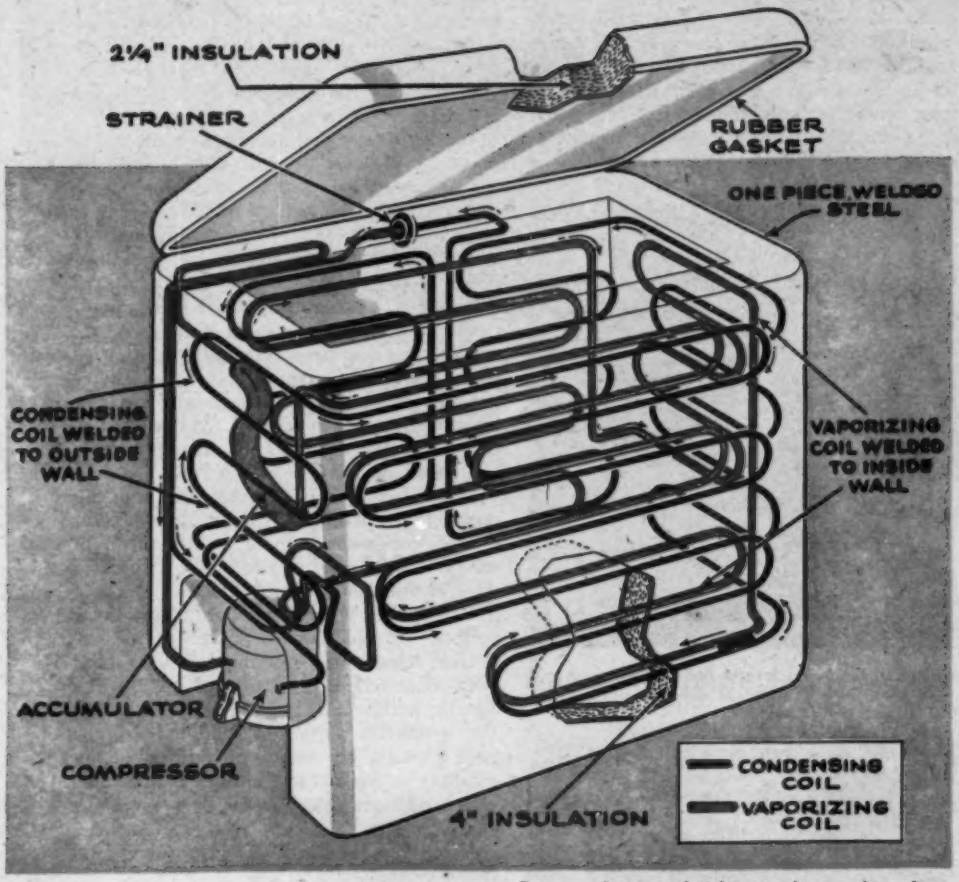
Philco's five-cubic-foot freezer has three sections, one for freezing and two for storing food.

picture from 1937 when freezers were home-made or custom-built.

The model of freezer purchased should be based on where the buyer lives, the size of the kitchen, and the amount of food to be preserved. Three general types of freezers are available now. The manufacturers admit that none of the existing designs is wholly satisfactory, but add that keen competition is bound to bring improvements—soon. One model is the old standby, the refrigerator, brought up to date by the addition of a low-temperature frozen-food storage compartment. Another is the chest type, with a lid on top. The third is the upright type with a front-opening door. The last two usually have space for quick freezing and a compartment for frozen food storage.

For a city apartment dweller with a pint-size kitchen, the dual-temperature refrigerator with storage space for a week's supply of frozen food should suffice. A suburbanite with a kitchen garden, however, will want a freezer big enough to put up a winter's stock of food—a six- to nine-cubic-foot unit holding about 300 pounds should be ample. On a farm, a year-around food supply probably will come out of the freezer, and the supply

The General Electric model on the left freezes and stores food in top section. Bottom is regular refrigerator. The large size Coolerator on the right stores fruits and vegetables, has removable bin dividers.



Cutaway drawing of Kelvinator freezer shows features contained in many modern home freezers.

of energy available should set the size of the box.

In buying a freezer it should be kept in mind that if it's more than 29 inches wide it probably won't go through a house door.

The freezer with a lid on top costs less because it is more economical to build than the model with a front door. The lid type doesn't frost as much, either, and frost is the bugaboo of freezer operation. Frost is caused by what refrigeration engineers call "cold-air spill." In a freezer, cold air falls to the bottom, and the temperature is highest at the top. When you open the lid on a chest freezer, less cold air rushes out than when the whole door opens on an upright freezer. But since a freezer is opened on an average of only twice a day, as compared with the 40 times a housewife goes to the refrigerator, the loss from cold air spilling out and hot air pouring in does not amount to five cents a month. Also, a refrigerator has to be defrosted every other week, and a freezer but once or twice a year.

One drawback of the chest freezer is that it may be hard to find food in it. In the vertical freezer, the frozen food is as readily accessible on the shelves as it is in your refrigerator.

One of the points to check when shopping

for a freezer is the thickness of the insulation in the walls. Freezers are usually insulated with glass wool or cork, and more recently with cellular rubber, which is two-thirds lighter than cork. The freezer with five inches of insulation is the best buy. If there is less than four inches of insulation, cold air inside the box escapes and hot air is absorbed. Two freezers, identical in every respect except insulation thickness, were tested in a research laboratory. The cabinet with five inches of insulation cost $1.78 to operate, while the freezer with an insulation of only three inches ran the bill up to $2.54.

Closed, the Maytag freezer provides an enameled work table with a drop-leaf dinette board.

Here is one of the four models of Coldspot home freezers sold by Sears, Roebuck and Co. stores.

One of the greatest hazards in home freezing is overloading the box with food to be frozen, creating a rise in the freezer temperature. The food may spoil before it is brought down to 32° F. A few degrees above zero in the storage compartment can cause fruits to discolor, vegetables and fruits to lose vitamin C, and meat fats to turn rancid.

The best insurance against temperature variations is to make certain that your freezer has a thermostatic control, so that the temperature in the freezing compartment can be brought down to −20° F. for sharp freezing, while the zero storage temperature is controlled in the rest of the box.

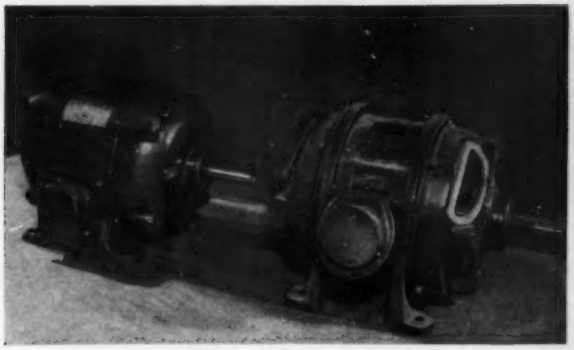
What happens if a storm cuts off the power that operates a freezer? If your unit is well constructed, there is little need to worry. No thawing will occur for about two days, if you *don't* open the freezer and if it is well packed with frozen food. For longer periods, fill the freezer with dry ice.

One scheme for rescuing thawing food from destruction is attributed to Boyden Sparks, author and home-freezer authority. For protection against a sudden blaze, he kept a couple of carbon dioxide fire extinguishers in his house. During a hurricane which disrupted the power, he opened the cabinet, turned on one of the extinguishers, squirted the box full of CO_2 snow, and saved the day.

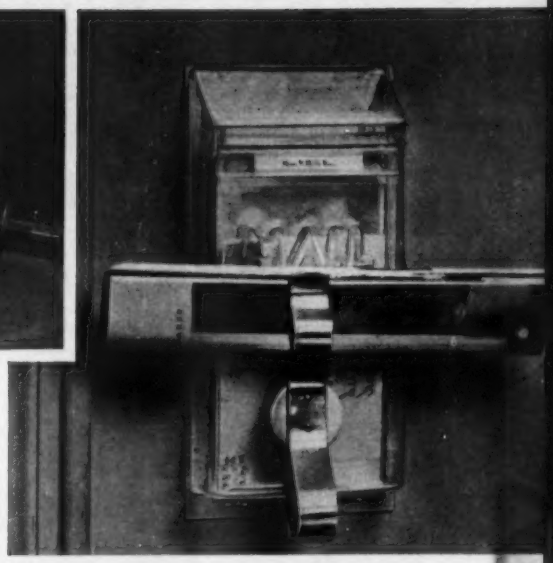
As a precautionary measure, your freezer should have an alarm system—preferably operated by batteries—set to ring before a dangerously high temperature is reached.

Although there's a freezer unit in the White House, you needn't be President to enjoy the benefits of a subzero grocery store in your own home. Prices now range from $150 for a two-cubic-foot model to about $600 for a 15-cubic-foot combination freezer and storage locker. As production increases, the cost is expected to decrease.

Practically all meats and fruits can be frozen successfully. Almost any vegetable survives the zero temperature, except lettuce and tomatoes which become limp when thawed. Cooked foods can be frozen, too, so a housewife can now cook the family's meals for a week in one day, and store them away, ready to heat and serve. END

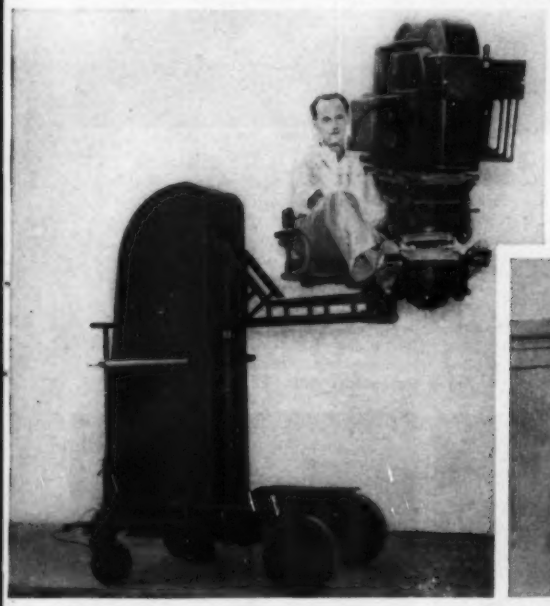


Smaller Motor Is Huskier. The streamlined electric motor on the left, above, is one-third smaller than the old cast-iron model at its right, but the new motor has 134 percent more turning power per pound of weight. Made by Westinghouse and called the Lifeline, it is the first all-steel model available to industry.

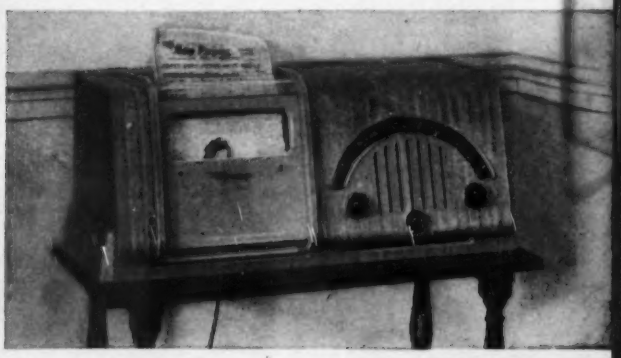


Mailbox Shows Contents. There is no need to open Celomat's new transparent Lucite mailbox to see if there's anything inside. It comes in various colors.

Camera Dolly Aids Closeups. Closeup moving-picture action shots pose no problem for the 1,000-pound camera dolly below. Electrically powered, it raises and lowers the camera as much as four feet and swings through a 290° arc. Controlled through foot pedals, it has a hand-set brake that holds the camera where wanted. It is built by Houston Corp., of Los Angeles.



Radio Prints Home Paper. One of three new Finch FM-AM and facsimile radio receivers, the table model below comes in different woods to harmonize with varied styles of home furnishings. The receiver reproduces facsimile at the rate of four 8½- by 11-inch pages every 15 minutes. According to W. G. H. Finch, president of Finch Telecommunications, Inc., 12 or more cities will be broadcasting facsimile on FM channels early this year. These cities include New York, Chicago, Detroit, Los Angeles, San Francisco, Cleveland and San Bernardino, Calif.



Mechanics of LIVING

How PHONOGRAPH RECORDS are made

PSM Picture Story

by ROBERT F. SMITH and HARRY SAMUELS

THE silent black disk that makes noises when needled is chiefly shellac, lampblack and limestone. In its manufacture, however, pure gold, wax, glass, copper, nickel and sometimes chromium are used by the craftsmen who operate the intricate and delicate machines that squeeze sound into a scratch.

From beginning to end, the commercial manufacture of records is a tremendously exacting process. For example, 50 percent of the wax-coated glass disks on which the music is recorded are rejected before reaching the cutting room. The accompanying pictures tell the story.

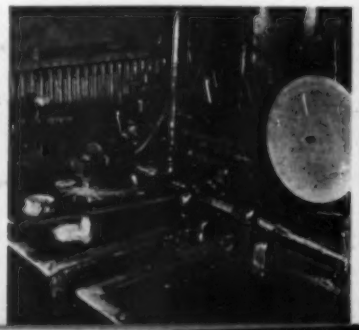
1. Liquid wax is poured on a preheated glass plate, the first step in making a master disk. The plate is then cooked until the wax forms a layer .028-inch thick. Then the wax is hardened.

2. Here music is recorded on the wax disk. Sounds picked up by the amplifier create electrical impulses that vibrate a sapphire stylus. The stylus cuts spiral grooves with wavy sidewalls. Cutting is watched through a microscope.

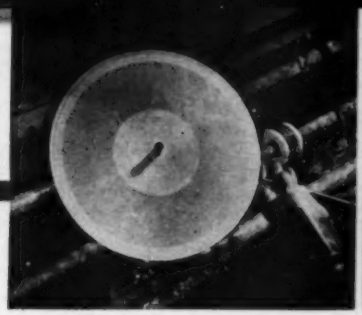
3. Cut with 88 to 136 grooves to the radial inch, depending on the length of the recording, the wax is put in a vacuum chamber to be "sputtered" with an extremely thin coat of 24-karat gold.

4. Center of vertical disk in background is a gold sheet (cathode) from which the wax disk, resting on a plate (anode), gets its gold finish via an 1,800-volt charge.

5. Another metal plating applies a crust of copper .035-inch thick to the gold-coated wax. At left, a motor spins a disk as it is plated. At right, a disk rests on a hinged board after plating.

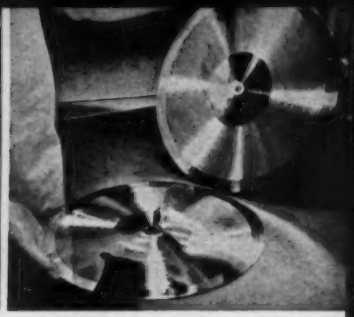


6. Plate is split and glass-wax core is broken from the gold-faced copper plate that now becomes the No. 1 master. Master has ridges where wax disk had grooves.



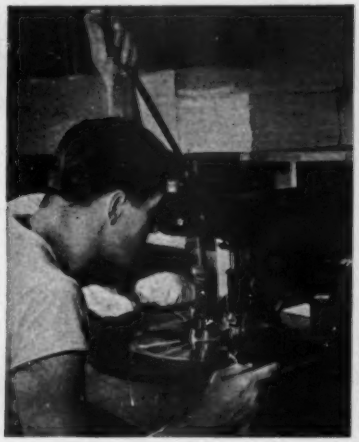
7. Here No. 1 mold, made from No. 1 master, has just emerged from a bath in which it acquired a thin plate of nickel to harden its face. A similar coat of copper completes the mold. Master and mold are still attached.

8. A separating tool detaches master from mold. No. 1 mold's face is an exact duplicate of the original recording. By subsequent plating and separating operations, No. 2 master is made from No. 1 mold and the final mold, No. 2, from No. 2 master.



9. Separation is now complete and No. 1 mold is ready to be used to fashion No. 2 master. The stamper, which presses the final product—the commercial record—is made from No. 2 mold.

10. The mold has an imperfect center hole. Here a craftsman solders a plug to the back of the nickel-faced copper mold in the first step toward putting a new hole in the exact center of the mold. This is a delicate operation.



11. Through a microscope mounted on a centering machine, the operator can adjust the placing of the disk so that its grooves run true around the center of the supporting plate. In the operator's left hand is a lever that he pulls to punch the hole when disk is centered.

12. The mold can be played. Here an expert listens to one in the RCA-Victor department where original masters are made. A defect in a recording is marked at its exact spot on the mold.

13. A rehabilitation expert (below) removes a clicking sound from a mold. At right is a close-up of a retouching job. The needle point of the tool actually fits in the groove and enables the craftsman to remove bumps and nicks. One expert spent six months restoring a Caruso master on which a worker had dropped a hammer.

14. Production of phonograph records starts with the mixing of a compound—shellac, lampblack and limestone — from which records are made. Here a machine rolls the mixture into a long blanket.

15. As the blanket of compound travels on the machine's belt it is cut into six-inch squares by the knife edges on the roller. After they have been cut, the squares continue on the belt and pass under blowers to be cooled and dried until they are in a brittle condition.

16. At the end of their journey, the squares are stacked for future use in the record-pressing room. Lampblack is added to the compound out of which the squares are made only to give the finished record its color.

17. In the pressing room enough squares to make a record are placed on a steam table and heated until they are pliant. Pressing-machine operator folds the square to make a "biscuit," as the trade calls the presser compound.

18. This is a pressing machine about to make a record. In the top section is the stamper for the B side of the record. Its label is on the spindle in the center. In the bottom section is the A-side stamper, its label barely visible under the biscuit. In foreground are labels and the tool used to lift the record.

19. Here a record is made in the presser, a machine resembling a waffle iron. Pressing is done automatically. Steam at 310 degrees F. heats the stampers, and the compound is forced into the impressions on the stampers by a pressure of 1,800 pounds.

20. The press is opened and a record, now nearly finished, is removed. The label for the next B side is already in position. Skilled operators turn out a record about every 48 seconds.

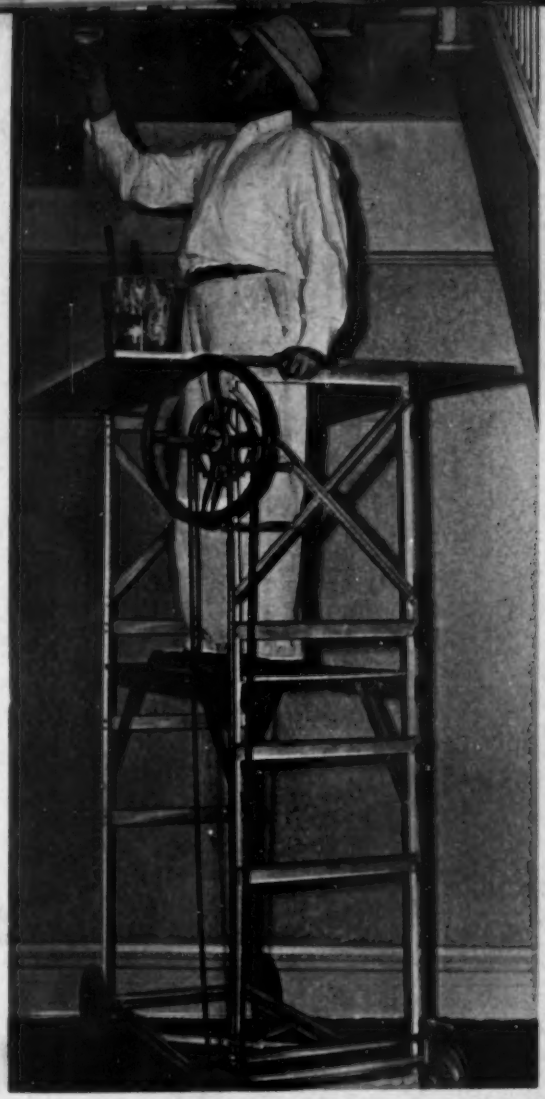
21. The record comes out of the pressing machine with rough edges, but except for that it is ready for music stores throughout the nation. RCA-Victor is continually experimenting with new materials for making records.

22. The record is held by two felt-covered plates and rotated. A girl holds a piece of emery cloth against its rim to smooth its edges. Next it is slipped into an envelope, ready for market.

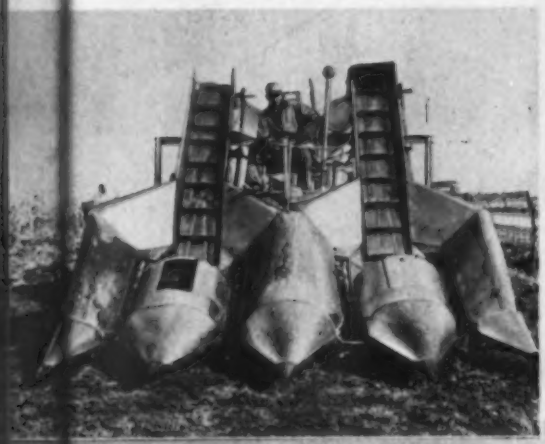
PIN-UP

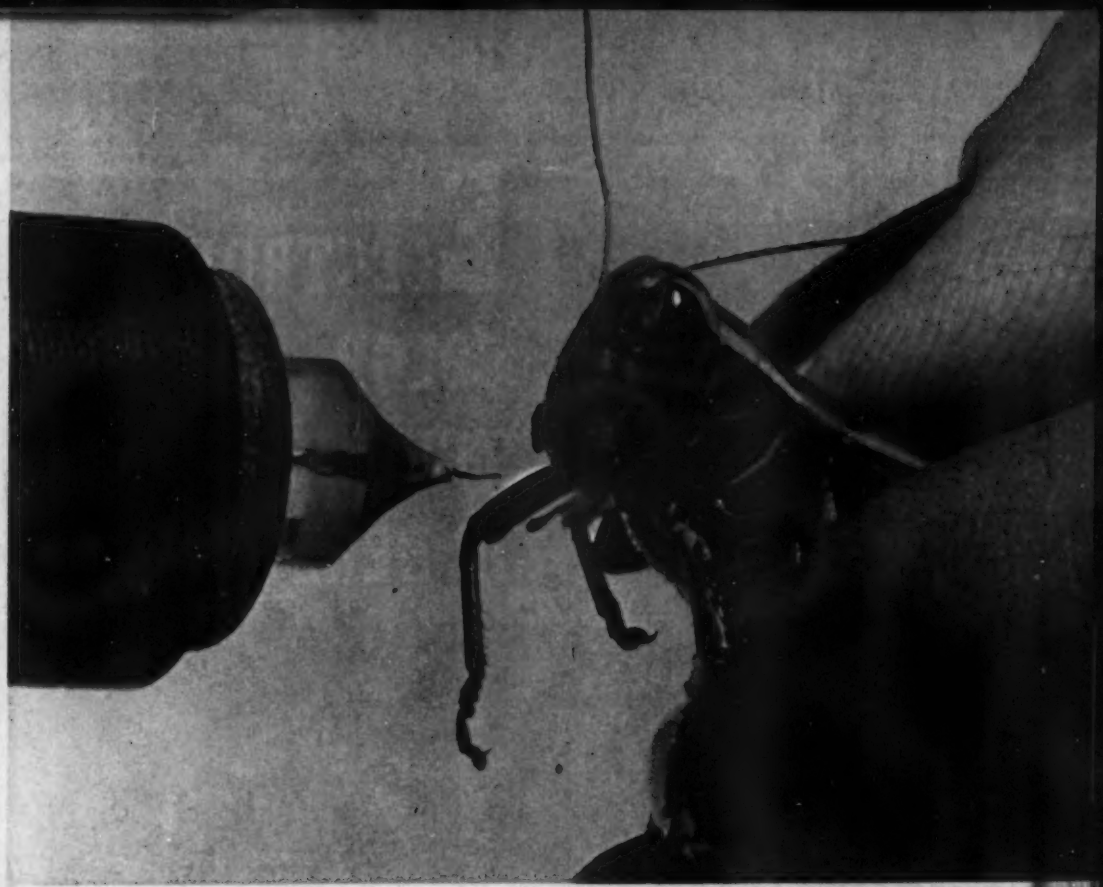
Potentially the fastest propeller aircraft in the world, the Navy's XF5U-1, the Flying Flapjack, is now powered by two 2,000-hp. engines that give it a speed range of 40 to 425 m.p.h. Chance Vought hopes eventually to install gas turbines, expects then a range from 0 (pure hovering flight) to more than 500 m.p.h. Flapjack has a radically long nose landing gear because it sits down with its nose pointing up, its wing acting as a flap.

Rolling Ladder. Built on wheels for portability, the 6½-foot-high aluminum "ladder" at right is propelled by turning the wheel, attached to a chain drive, at its top. The two shelves for holding materials are removable. The device was designed by Sam Dimon, of Los Angeles.



Four-Row Corn Picker. By combining a pair of two-row Oliver corn pickers into one unit in his El Paso, Ill., farm workshop, Lester Pfister devised the first four-row corn picker, shown below. He has since built three more. Pushed by a tractor and powered by a combine engine, the harvester's five claws, set on an angle in front, strip cobs from four rows at a time. Two belts then convey the cobs into a husker, which deposits them on another belt that runs to a trailing wagon. The picture at bottom of page shows the pickers at work. One machine accomplishes the work of 30 men.

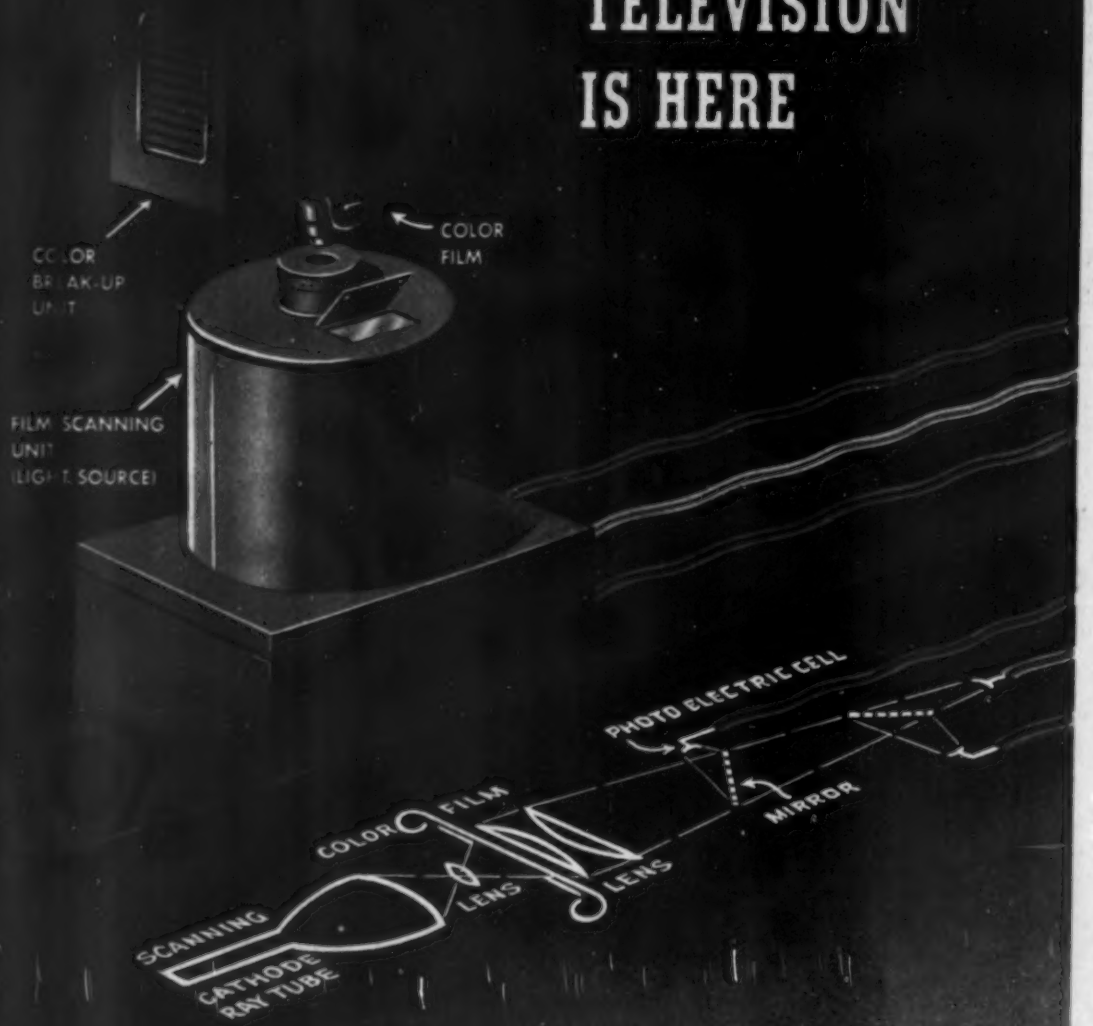


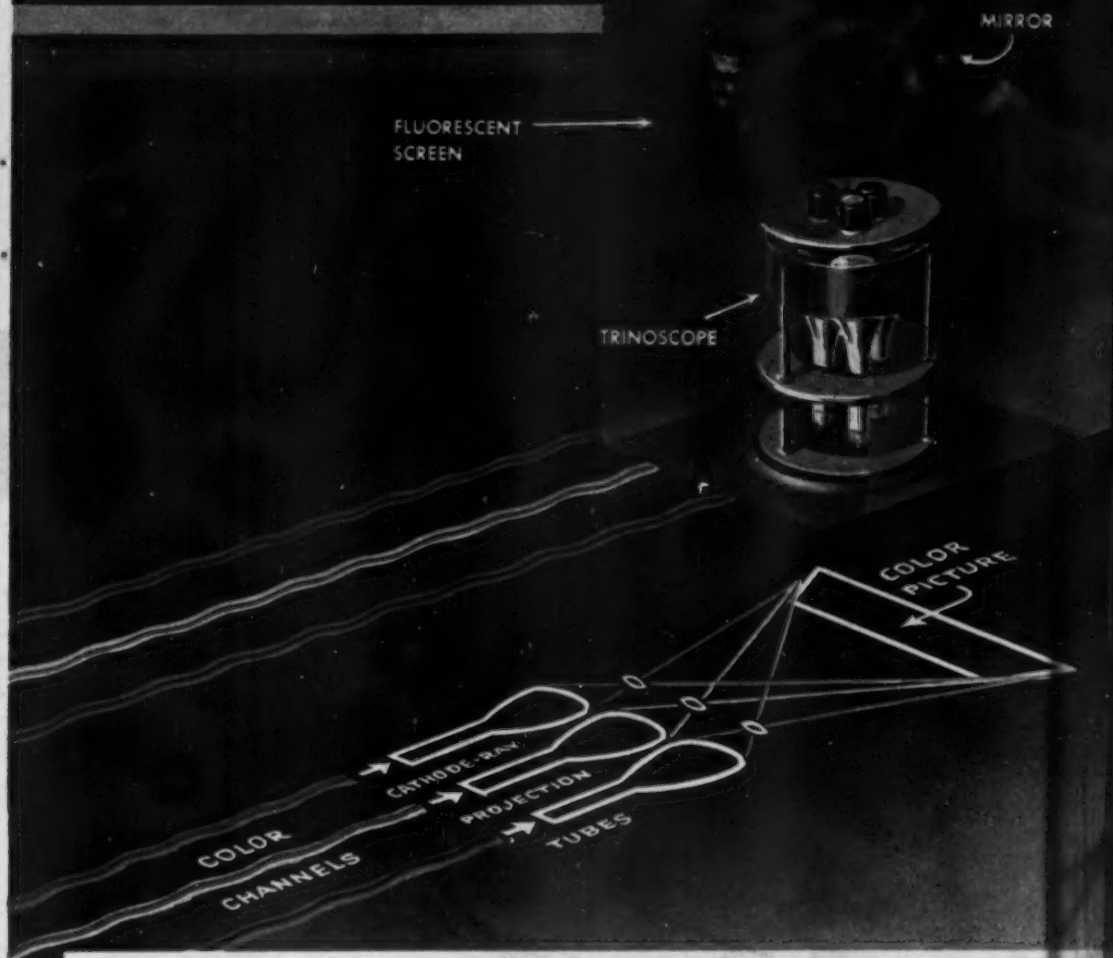


Taking a Grasshopper's Temperature. When and where grasshoppers will feed is a multimillion-dollar question to harassed U. S. wheat farmers. One answer recently offered by Montana State College entomologists, Profs. J. K. Pepper and E. B. Hastings, is that it depends on the pests' body temperatures, the sunlight's intensity, and the air's temperature. To help the investigators take grasshoppers' temperatures, General Electric designed a delicate thermocouple, 5/1,000 inch in diameter. It is shown above about to be inserted into a 'hopper. The data it supplies will help the scientists tell farmers where and when to spread poisoned bait.

Muscles for a "Tin Can." Each of the twin main reduction gears at right will transmit 30,000 hp. to drive the propellers of a 2,200-ton destroyer, largest U. S. type. The gears, built by Westinghouse, perform the final step in slowing the speed of the steam turbines' spindles to the speed of the ship's screws.

ELECTRONIC COLOR TELEVISION IS HERE



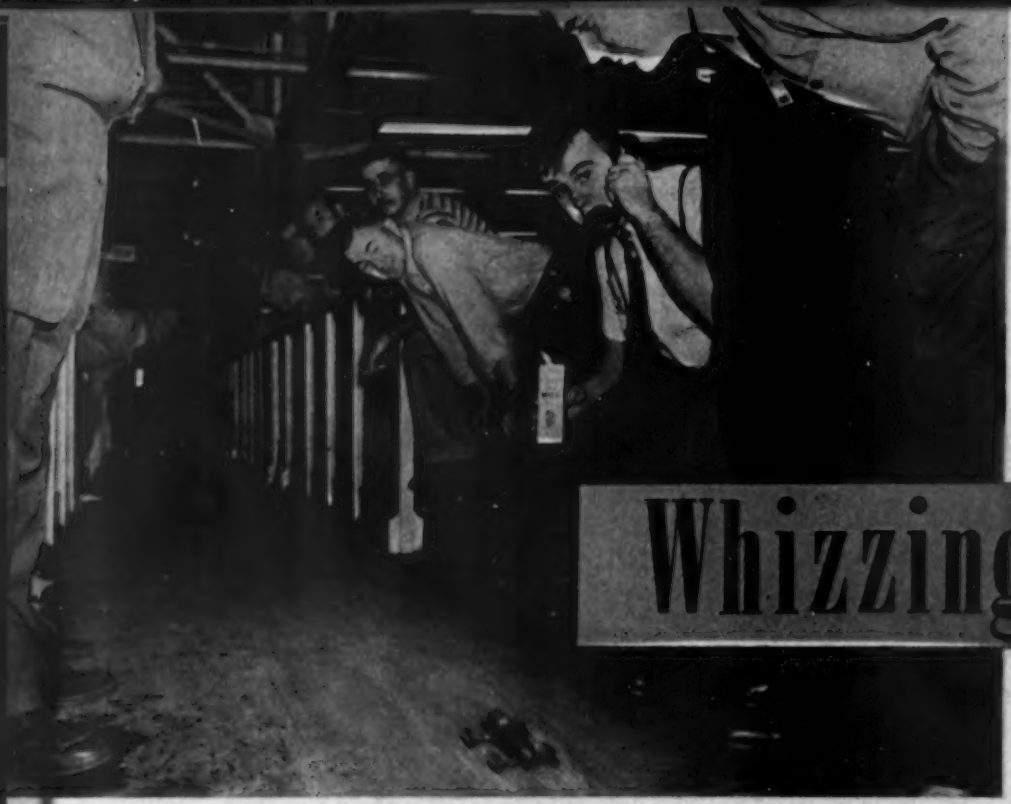


ALL-ELECTRONIC color television, which RCA engineers have achieved in a form that does not make black-and-white equipment obsolete, is a complete departure from the mechanical color transmissions of recent years. Mirrors and photoelectric cells replace moving parts.

In a recent demonstration at Princeton, N. J., pictures were broadcast with a new color-slide camera. Its developers plan laboratory transmission of live-action studio scenes by mid-1947, outdoor action scenes late in 1947, theater-size pictures in 1948.

The electronic system's mirrors and tubes split a beam of light into red, blue, and green images. Three kinescopes in the receiver pick up the separate images simultaneously—in contrast to mechanical systems in which a rotating filter transmits the three colors one at a time—and project a merged, flickerless picture.

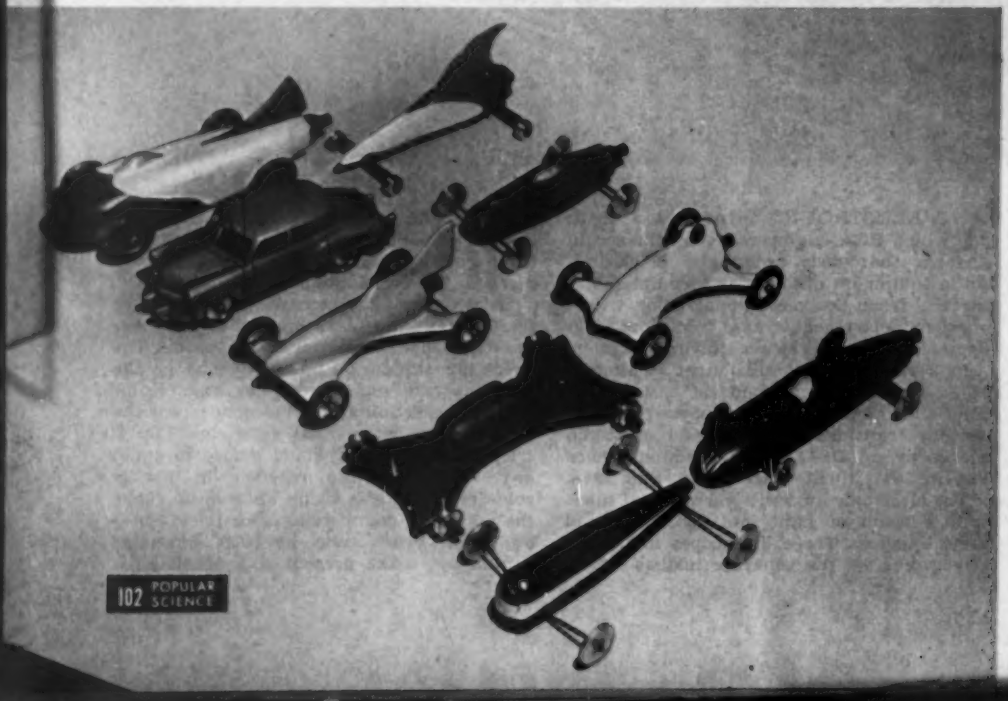
Color television requires much higher frequencies than black-and-white work because a wider band must be used. The operating standards, however, such as the scanning rate, number of lines, and rate of picture repetition (30 per second), are the same as in commercial television. So a frequency converter would suffice to equip any black-and-white receiver to handle color broadcasts in black and white. Thus the advent of commercial color television—still some years away by RCA estimates—need not make present sets obsolete.



Whizzing

They're off! The squirrel-size vehicles hit speeds around 50 m.p.h. over a 240-foot straightaway in an aisle at the sprawling Santa Monica plant. They are timed to an accuracy of 1/40 second.

The cars (below) are of hollow balsa, weigh from 7/8 ounce to 4 1/4 ounces. Those under 2 1/2 ounces are in the light class—those above, in the heavy. They're guided by strings, stopped by a curtain.



Each machine is weighed in before a race. This one balances a one-ounce weight. The racer has thin aluminum wheels that turn on steel bushings.

A racer's power plant—a cartridge for a soda water siphon—is inserted into a hole drilled into its tail. This 2½-ounce baby rolls on hard rubber tires.

on FIZZ

Douglas Aircraft engineers enliven noon hour by racing tiny cars jet-driven by CO_2

An owner (below) awaits the "go" signal to shoot his car down the track by puncturing its carbon-dioxide "engine" with a needle-tipped plunger. Size of puncture in cartridge depends on car's weight.

Screw eyes, bent wire, and cotter keys with an arm removed form snap-on guides for the string that keeps the racers in line. Tool experts make the cars.

The finish! A black job is about to crash the rolled curtain that stops cars. Racers sometimes swerve off course and smash to pieces against the wall.

THINKING IN

PSM photos by HUBERT LUCKETT

Above model at left is alternate unit that turns out synthetic gasoline. It was made by Monsanto and [illegible] the glass blowers shown at work below. Yellow vessel of [illegible] acid catalyst, which feeds into red reaction vat. Hydrocarbon gases enter through red tube at upper right and are bubbled in yellow condenser at right. Heater strip [illegible] and stirrer rockets to agitate catalyst and condensed gases. Tube with green coil at right of motor returns unreacted gases to vat.

GLASS

Above: Margiotta burns a hole into a bulb he has fashioned. Borrowing material from a solid glass rod, he builds up a flange around the rim of the hole. The adjustable gas burner over which he works is common to most glass blowers' benches. Below: Margiotta seals tube to the vessel in which he made the hole. The complicated apparatus on which he is working, every part turned out by himself, is a high-vacuum diffusion pump that will be used experimentally in the laboratory instead of as a part of a refinery mockup. Kellogg's technicians make most of the glass apparatus used in different Kellogg laboratories.

Acid-treating plant above removes sulphur, raises quality of petroleum products. It is typical of glass technicians' skill.

By J. S. QUALEY

MOST of our giant oil refineries have glass skeletons in their closets. Before they spill one drop of gasoline, lubricants or other by-products of crude into the pipe lines or the stomachs of water, rail and highway tankers, their efficiency at squeezing out every cubic centimeter of value has been planned and proved in glass models sitting atop stone tables in engineering laboratories.

Actual creators of these refineries are the glass constructionists who fashion the prototypes. Typical of scientific glass blowers are three men in the laboratory of the M. W. Kellogg Company plant in Jersey City, N. J.—master glass constructionist

T. A. Graf, and his staff of two, Robert Connelly and James Margiotta.

These three apply their craftsmanship and knowledge to creating increasingly improved methods of processing crude oil. The diminishing oil reserves and the changing nature of these resources make the work of the glass technicians of world economic significance.

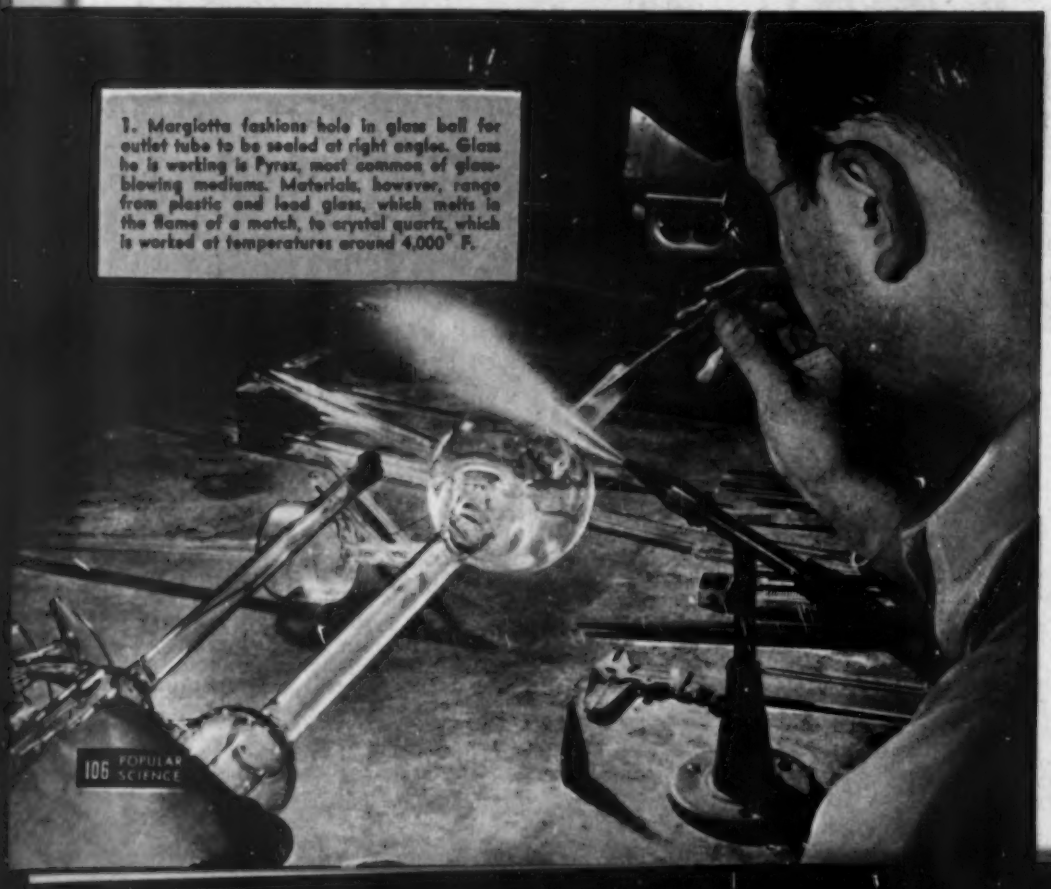
Kellogg's is an engineering construction firm specializing in perfecting refinery methods to meet the ever-arising problems of individual companies and newly discovered oil fields. Its laboratories and shops in Jersey City provide all the services required by the oil industry. One example of the projects designed and constructed by Kellogg's is the famous catalytic cracking plant at Aruba, in the Netherlands West Indies. The Aruba "cat-cracker" played a historic part in supplying the Allied needs for all types of petroleum fuel in World War II, and is still producing in heavy quantities.

To do the creative and precision work required at Kellogg's, glass constructionists need a variety of talents approaching those of the many-sided Leonardo da Vinci. They must not only be able to turn glass into the most intricate and exact shapes; they must be practical physicists, chemists and engineers as well.

As often as not, glass blowers fashion working glass models for new petroleum processes without benefit of blueprints or sketches. In such cases, an engineer explains the problem to be met, and how he thinks the desired ends may be attained. Then the glass constructionists go to work. They blow the parts they figure are needed for the type of unit that will be most efficient in handling the particular kind of product they want to process.

Not always, however, do the glass workers design the apparatus for new processes "out of their heads." On some jobs they work from engineering drawings. But even then they must have a knowledge of all phases of the oil-refining field—of furnaces, reactors, regenerators, fractionators, and so on.

When all the glass parts needed have been turned, they are assembled into a model of the unit the glass craftsmen and the engineers had in mind. Then actual tests, using the crude oil to be tested, are



1. Margiotta fashions hole in glass ball for outlet tube to be sealed at right angles. Glass he is working is Pyrex, most common of glass-blowing mediums. Materials, however, range from plastic and lead glass, which melts in the flame of a match, to crystal quartz, which is worked at temperatures around 4,000° F.

run through the assembled laboratory unit.

These glass mockups are not fashioned to scale, but they do handle the ingredients to be processed in their real proportions. Once the models are operating as the engineers believe they should, they are copied in metal in a pilot plant. Then, through the pilot plant, larger amounts of petroleum are tested. Engineers watch the tests and make improvements and, finally, when the pilot works at utmost efficiency, it becomes the model from which Kellogg's will build commercial plants in the areas where they are needed.

This method, combining theory and experiment, has revolutionized oil refining in the last 10 years. Besides saving millions of dollars in petroleum products that might otherwise have been dissipated, the models and the pilot plants have supplied valuable data for the oil industry.

How long does it take to become a glass blower proficient enough for the tasks required in such a laboratory? "If you start young enough," Graf says, "and are suited to the work, you should be good about the time you're 40."

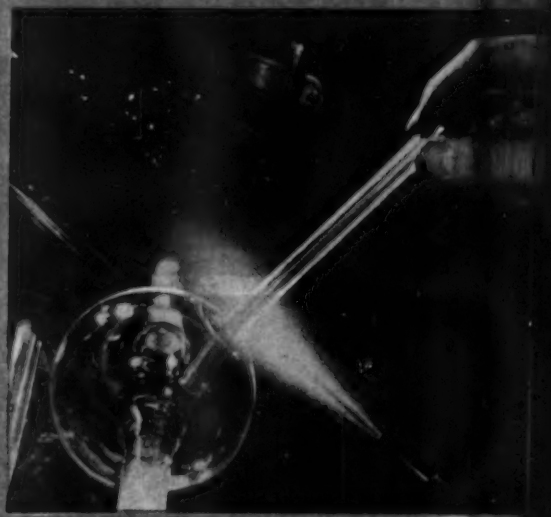
Graf started at 14. He got his training in Europe. He didn't choose his career, but was assigned to it by the government in the person of his school teacher. His apprenticeship lasted four years—seven hours a day doing manual work, three hours a day studying engineering, chemistry and physics. After that he had to serve a two-year "internship" with one company. When a course like his was finished, a European glass blower was considered about ready to earn his salt in the scientific field. If he wanted to go into the commercial field, however, he could make fair money as a blower of knickknacks.

It's easier in the United States, because there is no set period of apprenticeship. Most American-developed glass turners learn their profession, as young Margiotta did, in laboratories such as Kellogg's, under masters such as Graf.

Connelly is a graduate of a third school of glass blowing—the family. Orphaned as a child, he was taken into the home of an uncle, a glass blower, who started Connelly's tutelage at the age of 12. Before joining Kellogg's staff, Connelly did precision fabricating for RCA.

Margiotta is getting his scientific back-

2. Continuing on his project, Margiotta blows into a tube to create the visible bulge, which is just about the size he wants it. When it is exactly right, he has to take it out of the flame, let it cool, notch it with a file, and crack it smartly across the edge of his bench to divide it in the middle of the protuberance. For him, this operation is one of the simple ones.



3. Here Margiotta fuses the spread end of the upper half of the tube into the hole he prepared in the bulb. Next, the apparatus is placed in a furnace and annealed by heat intensified 100° F. every hour for 12 hours. Then it is cooled at the same rate for the same length of time to give it integrated strength.

ground at Columbia University at night, studying for a B.S. degree. As a GI, he supervised a large glass-blowing staff at the Oak Ridge atomic project during the war. Incidentally, long before the Oak Ridge plant was functioning, glass blowers had fashioned models of the apparatus that was to open so large a door to the future.

In addition to a rigorous education and wide knowledge, a glass constructionist must have the right physique—true eye and a sure hand for delicate work, and stout muscles for turning out cumbersome

Grief, upper left, turns ends of double tube in the preheating it preparatory to making [illegible] the extension of tube. At left, below, he [illegible] in bubble. When inlet tube has been fused [illegible] project will be a prototype of a refinery's [illegible]

glass units that often weigh many pounds.

To appreciate the muscles and stamina needed in the working of glass, it must be remembered that once a job is "in the fire" there can be no letup in the turning, pulling, twisting and blowing until the piece is finished—even if it takes 10 hours. A few seconds out of the fire can ruin a painstaking, costly job.

And the right temperament is also necessary, for they do work that would sap the patience of an engraver on the heads of pins.

A true eye is as essential to an engineering laboratory glass worker as exact pitch is to a concert singer. Much of the work at Kellogg's precludes the use of measuring aids. The spiral in a glass coil or an elbow of tubing cannot be measured while the worker keeps weaving it in and out of his flame. The eye carries the entire responsibility.

To split a hair, the class of work done by Kellogg's staff is not properly called glass blowing. Rather, it is glass constructing—or fashioning. Only occasionally is it necessary for the technicians to puff into a glass or rubber tube. Mostly they turn, pull and twist their mediums into shape.

Judging from past performances, even more intricate glass skeletons for greater, more economical petroleum and chemical refineries of the future are certain to come out of the heads and the flames of the laboratory glass technicians. END

Connelly builds a tube out of crystal quartz, the most grueling kind of work in the business. Crystal quartz is the hardest, purest medium worked by the glass technicians. Connelly makes his specimen from granulated quartz, which is first washed in sulphuric acid and distilled water and is then picked up from a saucer underneath his burner.

Three Routes to SUPERSONIC FLIGHT

ENGINEERS, striving to build a flying machine that will carry human beings faster than the speed of sound, have only three modes of flight with which to do it. These illustrations, used by Douglas engineers to explain the basic theories of flight, portray the principles upon which supersonic aviation must depend—until science thinks up something new.

THRUST. Like a Fourth of July skyrocket, thrust-driven devices such as V-2s and the Wac Corporal depend upon the energy of their fuel charge and need no air to sustain them. Rocket speeds range up to 3,500 m.p.h., and this form of power may give man his first taste of supersonic flight.

WINGS. Airborne flight, represented in its simplest form by a child's paper airplane, utilizes aerodynamic forces, created by the action of air upon a wing passing through it, to provide lift. Limited partly by the very wings that sustain them, man-carrying airborne devices have as yet only nibbled at the bottom edge of the sonic barrier.

MOMENTUM. A cannon shell, like a pebble from a boy's slingshot, illustrates momentum-borne flight, in which an object is set in motion by a force greater than its own inertia and then coasts. Momentum plays a part even in the flight of thrust-borne devices after their fuel is exhausted, but true momentum-borne missiles carry no fuel and have no continuing propulsion.

I'd like to see them make

Cartoons by SYD LANDI

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay five dollars for every such suggestion that its editors decide to publish.

Catsup Tamer. Not too much, not too little, with this catsup regulator, says Bill Hopewell, of Cincinnati.

Fireside Lie Detector. It would put an end to tall tales around the house, declares Mrs. R. L. Clark, of San Jose, Calif.

Back-seat Ejector. The automotive device above is the interesting brain child of David E. Mann, Jr., of Needham, Mass.

Throat Saver. Eye-and-mouth masks for nonsmoking movie-goers are suggested by William Lohorco, of Brooklyn, N. Y.

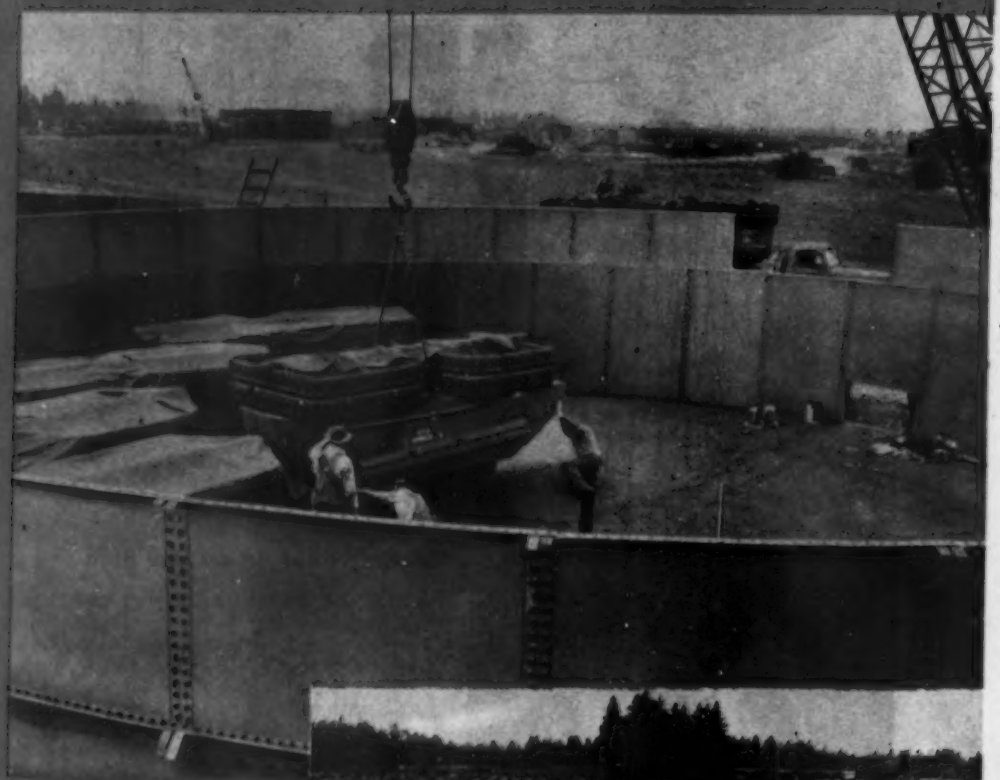
Squawking Purse. One that cries out if owner's grip is released appeals to Mrs. Ethel T. Cearley, of Compton, Calif.

Shake-up Wake-up. An awakening arm, not an alarm, is proposed by Sergio Horacio Paredes, of Brownsville, Texas.

Radar Works on an Ore Boat

BEFORE ice floes hampered navigation, ship owners had a chance to watch coveted radar at work on the Great Lakes. The ore boat *A. H. Ferbert* tested marine radar equipment on a six-day run. Outfitted with a Radiomarine Corp. wave-guide and reflector antenna (upper left) and an indicator unit (above), the *Ferbert* caught pictures that enabled Capt. Frank Davenport to distinguish between passenger ships and ore carriers at distances up to 25 miles. At left is one of the radar "maps." The *Ferbert* is the spot in the exact center, while the elongated white images are the banks of the St. Marys River between Lakes Superior and Huron. The dots ahead and astern of the ship are buoys.

Liquid Insulation. Reflecting 80 percent of the sun's rays, a new weatherproof aluminum roof paint made by the United Gilsonite laboratories can be applied to nonporous surfaces with a brush or spray at a cost of one cent a square foot.



STORAGE TANKS FOR TANKS. In an experiment in storing ordnance material so as to keep it ready for instant use, the Army is converting 33 surplus oil-storage tanks into sealed vaults for tanks and other vehicles. Above, processed tanks at Mt. Rainier, Wash., Ordnance Depot are shown in one partially erected, 55-foot-diameter storehouse. Until roof is bolted into place, contents will be protected by tarps. The storage containers will rest on the concrete, asphalt-covered bases at right.

CONSTRUCTION

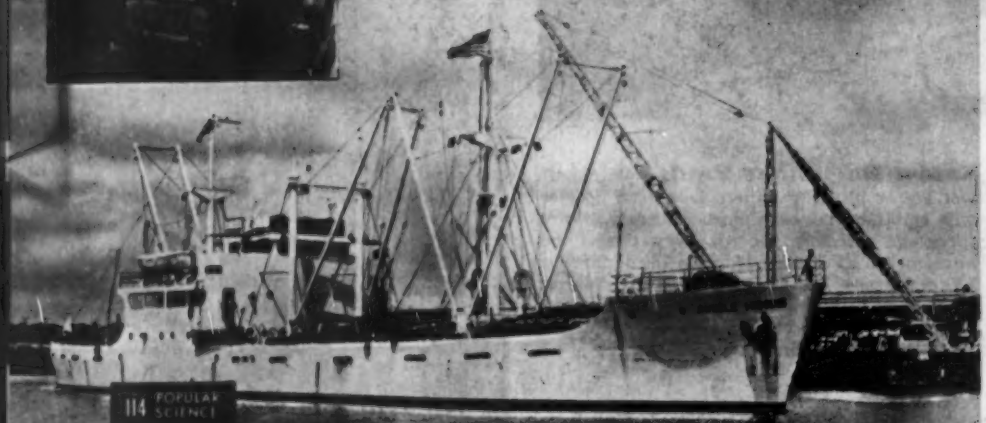
Dry-Land Navigation Training. Make-believe flights and voyages now eliminate risk while Navy students learn to use Loran, short for "long-range navigation" by radio. A transmitter, right, emits signals which are picked up by a movable "crab," representing a plane or ship, on the chart table above. Because radio waves travel too fast to be timed accurately on this miniature scale, they are replaced by sound waves, pitched above range of the ear but made audible by the special receiver at left. Listening in, the learner plots his position and then compares it with that of the "crab" to find his score.

Safest Document Vault. Without wetting or blurring papers, overhead nozzles will smother flames almost instantly if fire threatens priceless records, signatures, and agreements at United Nations headquarters, Lake Success, N. Y. Designed by Walter Kidde and Company, New York, the system releases a ton of carbon dioxide, automatically shuts doors and stops ventilators.

Road-and-Railer. Fitted for roads or rails, the postwar Evans Auto-Railer is guided on tracks by flanged, steel pilot wheels. Fifty percent of the load bearing and all driving and braking are done by the regular wheels, equipped with special-tread rubber tires having 3½ times the traction of steel railroad wheels. Pilot wheels lift hydraulically for road use.

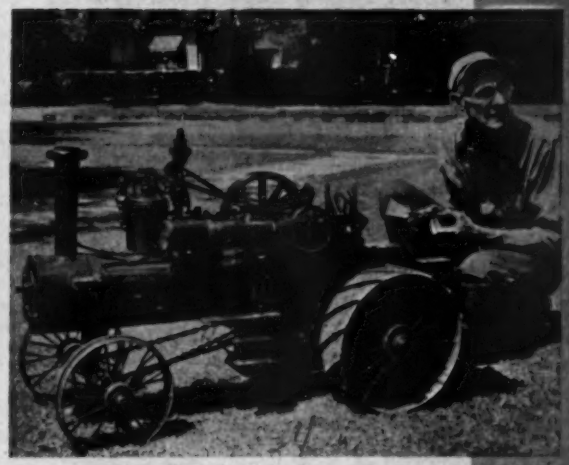
Super Coal-Heaver. If the clamshell bucket at the right were unloaded just once in the basement of the average American home, it would deposit enough coal to last two years. Built by Blaw-Knox Co. to speed up stock-piling from lake boats, it operates on a bridge-type crane and holds 17½ tons of coal—23 cubic yards.

AC on a Freighter. All auxiliary devices except cargo winches aboard the newly launched motorship *Angelo Higgins*, of New Orleans, (below) are operated by alternating current—a novelty on a cargo ship. Three 60-kw. generators are driven by three 120-hp. Hercules Diesel engines, one of which is shown at left. The complete plant generates 440-volt, 3-phase, 60-cycle current. Winches operate on AC-DC motor generator sets.



Farming in a Small Way

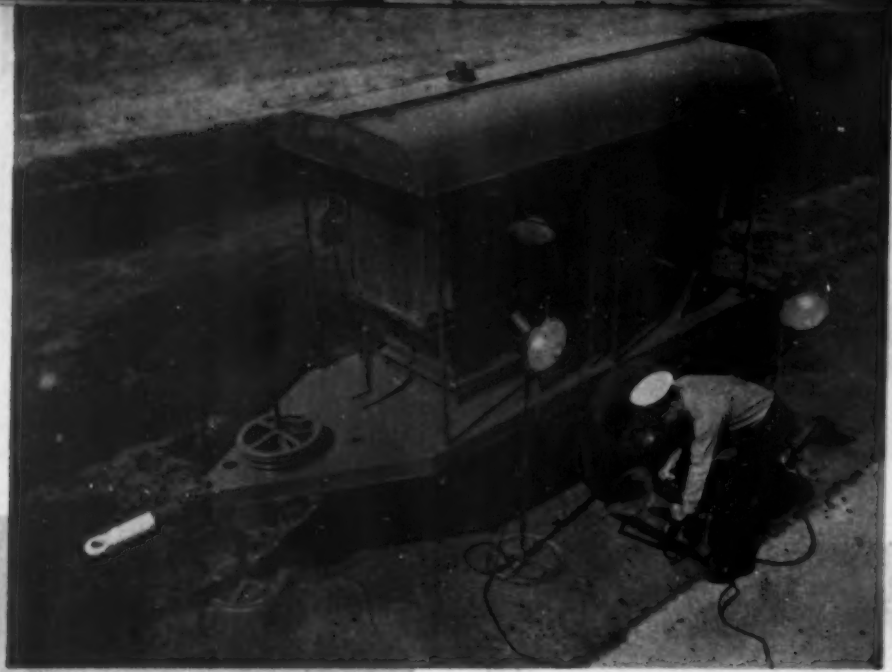
Van Baren tinkers with model on his lawn. Tractor weighs 260 pounds; thresher, 240.



Tractor even has a tiny shovel for coal. Below are the thresher's chopping blades.

RECALLING a vanished era of farming, John J. Van Baren, of Newton, Iowa, has reproduced an old-fashioned steam tractor, its water wagon, and a threshing machine. Complete to the tiniest detail, they do everything the originals did—but they are exactly one-quarter as big. Lacking engineering plans, Van Baren had to hunt down examples of the outmoded equipment for his measurements. With the exception of belts, chains, and a steam gauge, the models were made by hand. Their creation in spare time required eight years.

Miniature wheels change direction and angle of thresher's stacking pipe. It discharges straw.



Floodlight Truck for Fires. To provide illumination at isolated night fires or airplane crashes, the firefighting staff of the Douglas Aircraft plant at El Segundo, Calif., developed the auxiliary truck shown above. Mounting 10 floodlights of 200 watts each, it has a detachable fuse box with 18 plug outlets. The electrical equipment is powered by a 100-horsepower gasoline engine, and the truck itself is designed to be towed by any of the plant's fire engines.

Firecycle. Another specialized piece of equipment used by Douglas at El Segundo is this three-wheel motorcycle, which provides extreme mobility and permits close-quarter firefighting in narrow aisles or other confined places anywhere in the sprawling plant. It has been rebuilt to carry chemical equipment over the rear wheels, where separate recesses contain two 30-pound Du-gas extinguishers and four carbon-dioxide extinguishers—two 15-pounders and two two-pounders.

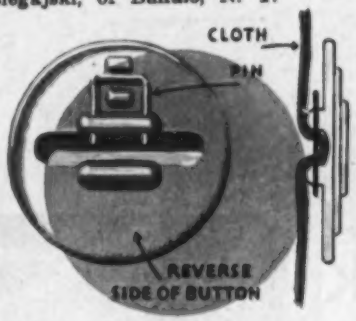
Twisting a Giant's Tail. In this towering steel skeleton, taller than a five-story building, the tail section of the Lockheed Constitution is hauled back and forth by hydraulic jacks to test its strength. The framework is counterbalanced to eliminate unnecessary stresses.

Flight Test Room. Ground tests completed, two flight engineers at the complex control panel, below, kept watch over the performance of the first Constitution to go aloft. Engine instruments are duplicated for safety. Paneling is of plywood.

Stress by the Ton. While hydraulic jacks thrust upward and water tanks in the fuselage exert a downward load of 15 tons, electrical gauges measure the stresses set up in Constitution's nose gear.

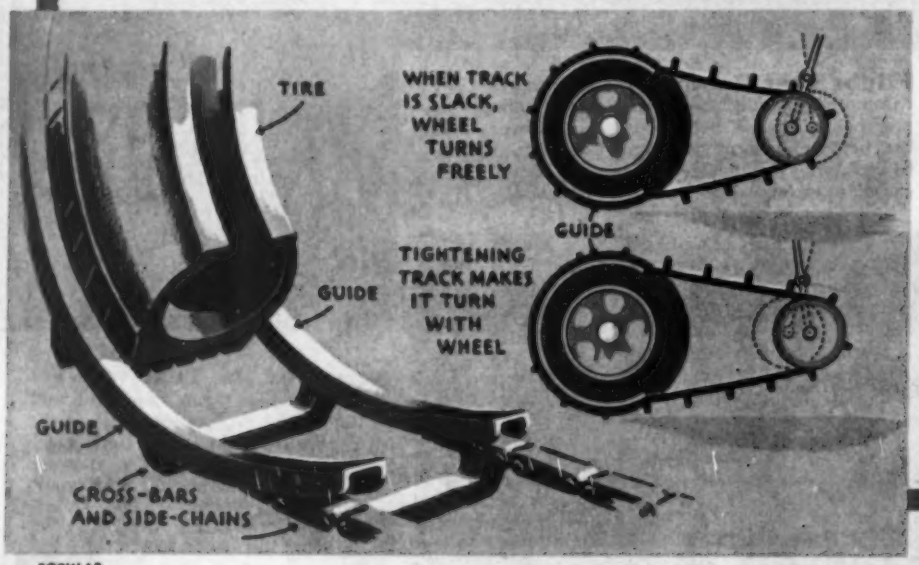
NEW IDEAS from the INVENTORS

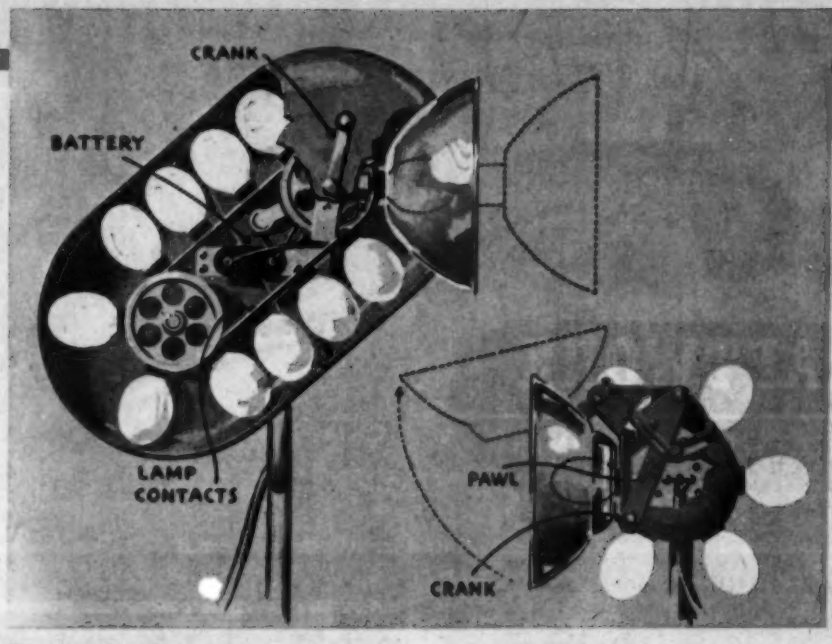
Threadless Button. Cloth is folded into a groove in the back of the button diagrammed below, and the button is fastened to the material by a staple. It was invented by E. W. Biegajski, of Buffalo, N. Y.



Pocket Lock. A zipper seal that makes the back pockets of trousers theftproof is pictured above. The antipickpocket guard was invented by Leopold Schonthal, of New York City. When locked, the zipper is closed all the way, and the chain, which is attached to the zipper clasp, draws taut and is anchored to a snap button inside a side pocket, so that it cannot be unfastened without arousing the wearer.

Nonskid System. For traction on slippery surfaces, the tire "chain," or track, diagrammed below can be put into action by merely pulling a lever. When the track is not in use, spring-loaded guides mounted on the axle hold it away from the tire, which then is free to run on the roadway through a gap left in the track's crossbars. Pulling the lever moves an idler pulley that tightens the track's guides against the wheel. The upper right-hand drawing shows the track in its free-turning position, tire resting on the ground; drawing below it, wheel as it turns the track. It was invented by C. W. Hunter, of Bryn Mawr, Pa.

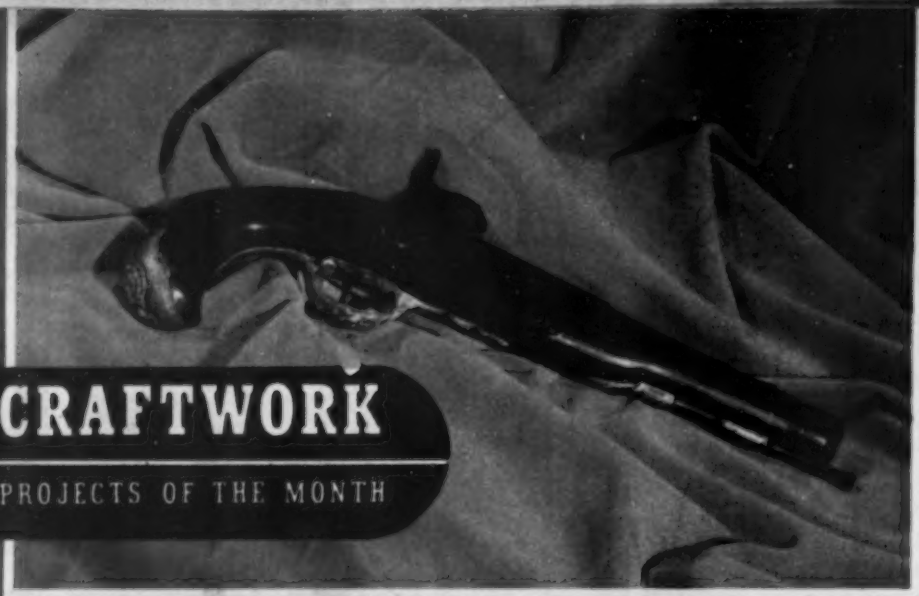




Repeating Flash Systems. Time-savers for photographers are the two lamps above, in which manually operated cranks replace spent bulbs with new ones, moving the reflectors out of the way as they do so. Once the fresh bulbs are in place, the reflectors return to position. The top lamp was invented by E. B. Nobel and A. W. Seitz, the lower one by John J. Malloy. Both devices use a series of bulbs with bayonet-type bases, and their discharge switches can be operated either by hand or by synchronizing apparatus.

Warning Light. An automatic warning of decreasing speed is provided by a light for cars and trucks devised by the Automobile Safety Light Co., of Chicago. The light, shown on the back of a car below, gets its current from a rear spark plug. When the engine is running fast, the light burns a steady, bright red. As speed is cut it starts to flash a warning that the car is slowing down.

Pickproof Latch. Prowlers will not find the new door latch above, invented by A. M. Chester, of Austin, Tex., as easy pickings as the old type. The new latch has a jointed shaft which buckles and buries its hook deeper into the eye when the shaft is lifted from outside the door.



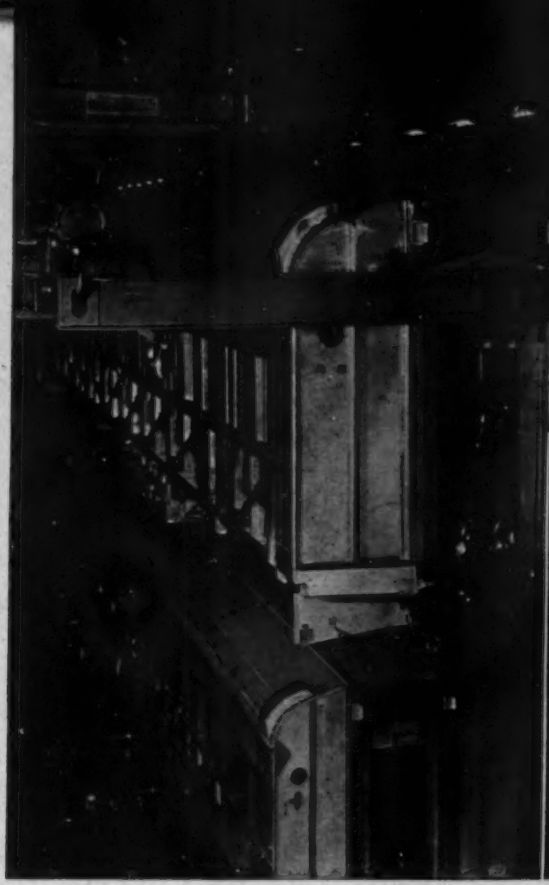
CRAFTWORK

PROJECTS OF THE MONTH

DUELING PISTOL. No project for clockspring whittlers, this accurate model of an old German weapon will give the painstaking craftsman a fine chance to show his stuff. Finishing wood to resemble metal is a crucial part of the job. You'll find pieces and suggestions for both carving and finishing in the article beginning on page 154.

TOY-BLOCK LAMP. A bright spot in a youngster's room, this lamp captures the gay spirit. It makes use of built-up wooden blocks, standard electrical fittings, and a shade covered with shelf paper. Details of construction are given on page 152.

SURREALISM IN THE BOUDOIR. Costume rings can be kept on this plastic hand for the dressing table, which gives that slightly bizarre touch dear to decorators. As described on page 160, it is cut and shaped from a single sheet of clear plastic and then mounted on a smooth, frosted-edge base piece that holds it upright.



Stitching Steel Into Streamliners

By MORTON C. WALLING

Budd's new assembly line rolls out cars like cans.

AS YOU stand on a catwalk high above the plant you can scarcely see where it ends, dim in the distance, five city blocks away. The workmen dwindle to mere specks, the gigantic U-shaped welders become tiny tweezers. Toward you stretch three long, silver caterpillars: assembly lines. Here and there comes a flicker of blue flame from an arc welder, reflected and reflected again from shining stainless steel. Occasionally there is a rumbling medley of thumps from shot welders; otherwise there is only a low hum from the thousands of workmen and machines.

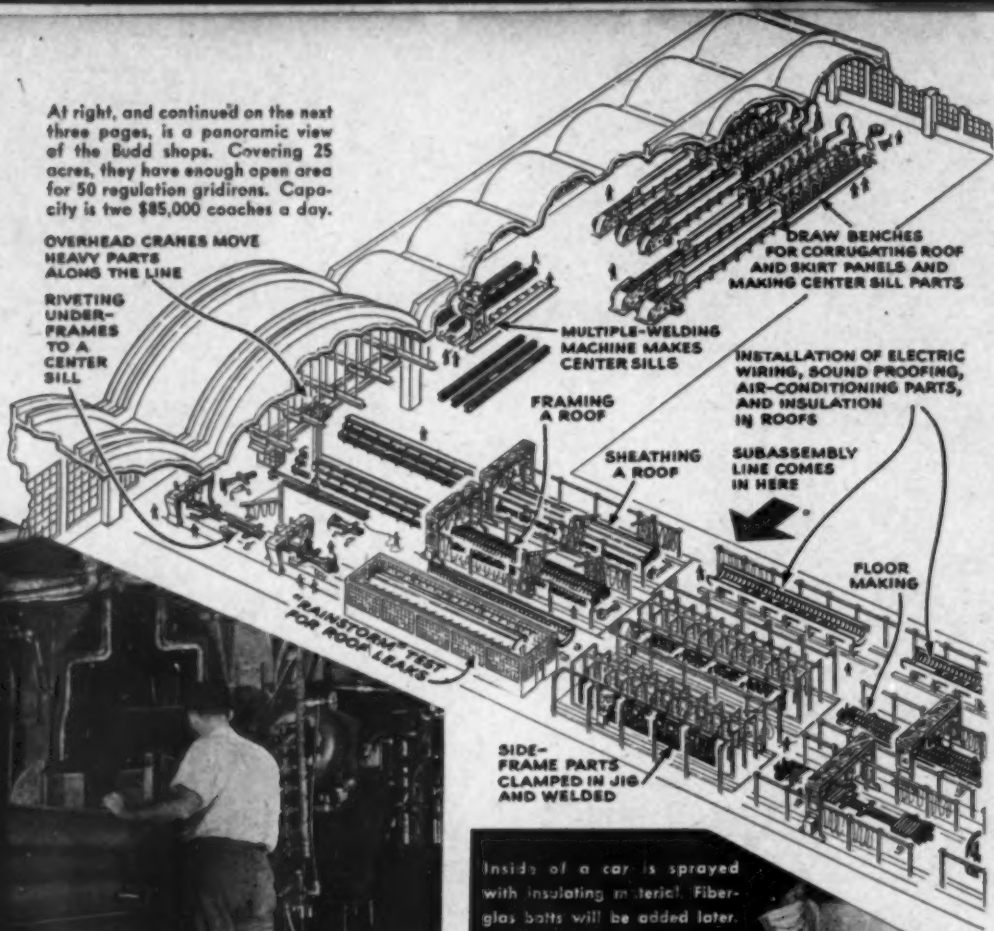
Here is modern technology in action—the assembly-line system the auto industry made famous. But as the great cranes swoop down along the line and the silvery bodies roll nearer and nearer you can see they are too shiny for automobiles—and too big. Each is as long as half a dozen motor cars—a stainless steel railway coach.

For this is the plant of the Budd Company, where the high-speed step-by-step assembly techniques they have long used in making all-steel auto bodies are applied to railway cars. And the result will be a new standard of comfort in railway travel, at a reasonable cost. By the application of Detroit methods to Philadelphia, what starts out as stacked rolls of stainless steel, varying from 1/10 to 1/4 inch in thickness, emerges a short time later as a finished railroad car, ready to be towed out and put behind a locomotive. In between are some quarter-million shot welds, 200 rivets—and some highly intelligent engineering.

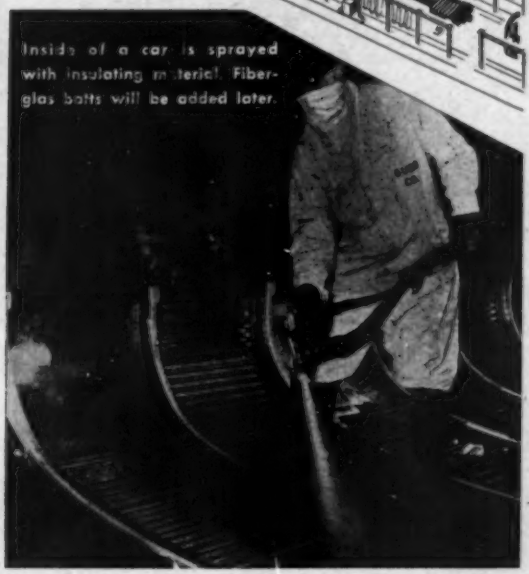
The first stainless steel train, the Chi-

STORY CONTINUED ON PAGE 126, FOLLOWING FOUR PAGES OF PICTURES

At right, and continued on the next three pages, is a panoramic view of the Budd shops. Covering 25 acres, they have enough open area for 50 regulation gridirons. Capacity is two $85,000 coaches a day.



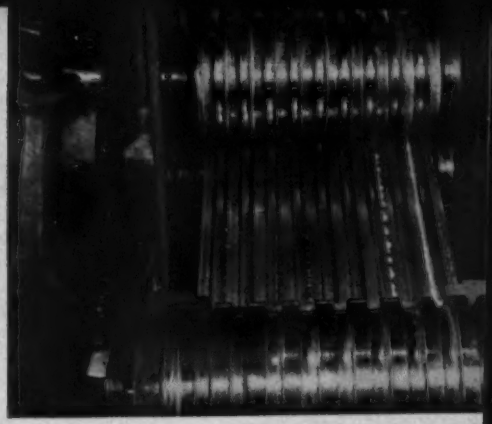
Above, a "walking welder" that in half a day joins the four 58-foot sections of the center-sill beam. With hand methods, job took a week.



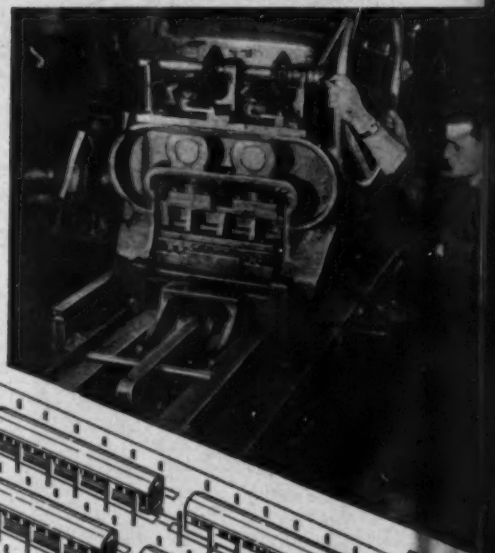
Inside of a car is sprayed with insulating material. Fiberglas batts will be added later.

At left, a button is pushed and the shot welder fixes roof panels in place. Roof is assembled right side up, inverted for more installations.

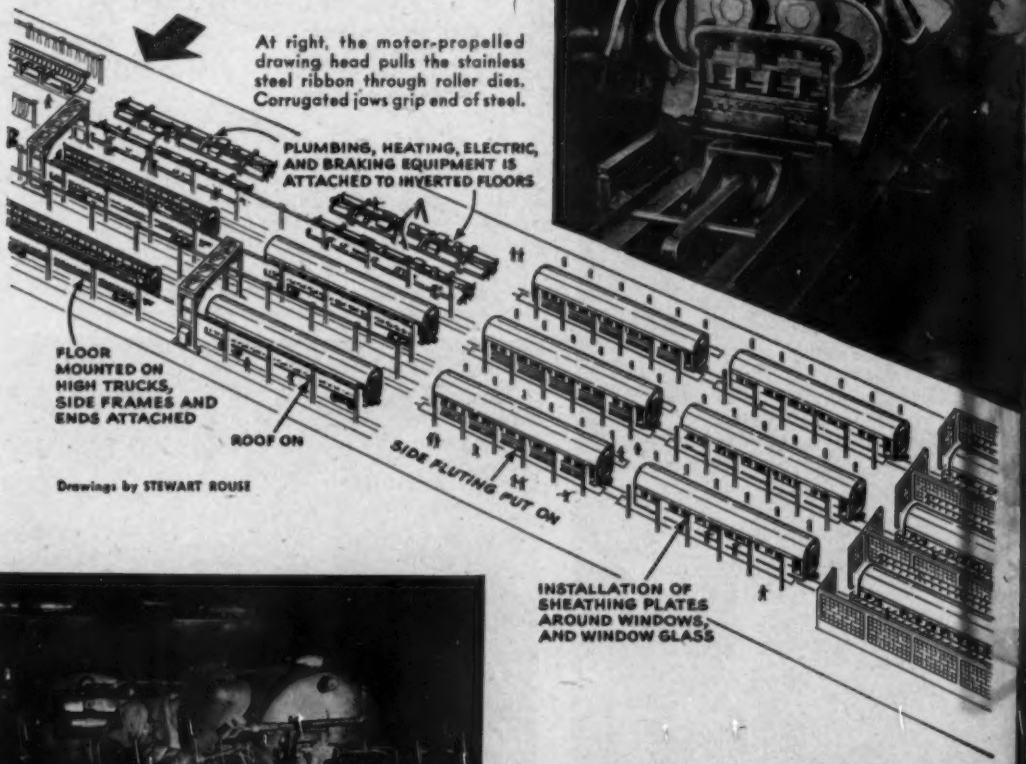
Above, the drawing bench puts wrinkles in stainless steel roof and side panels. A similar bench forms sections that make center sill, or car backbone.



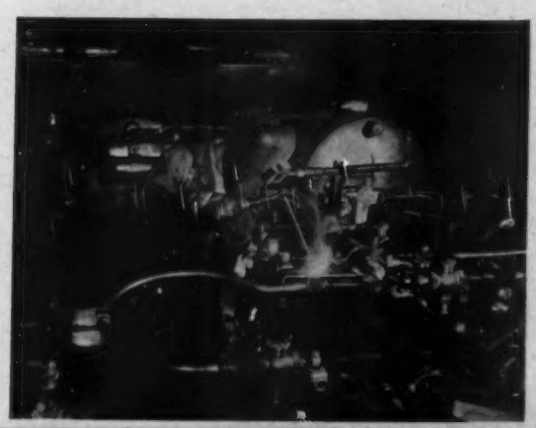
Roller dies above are the super-tough wringers that actually wrinkle the metal. Part of the drawing bench, each costs as much as $5,000.



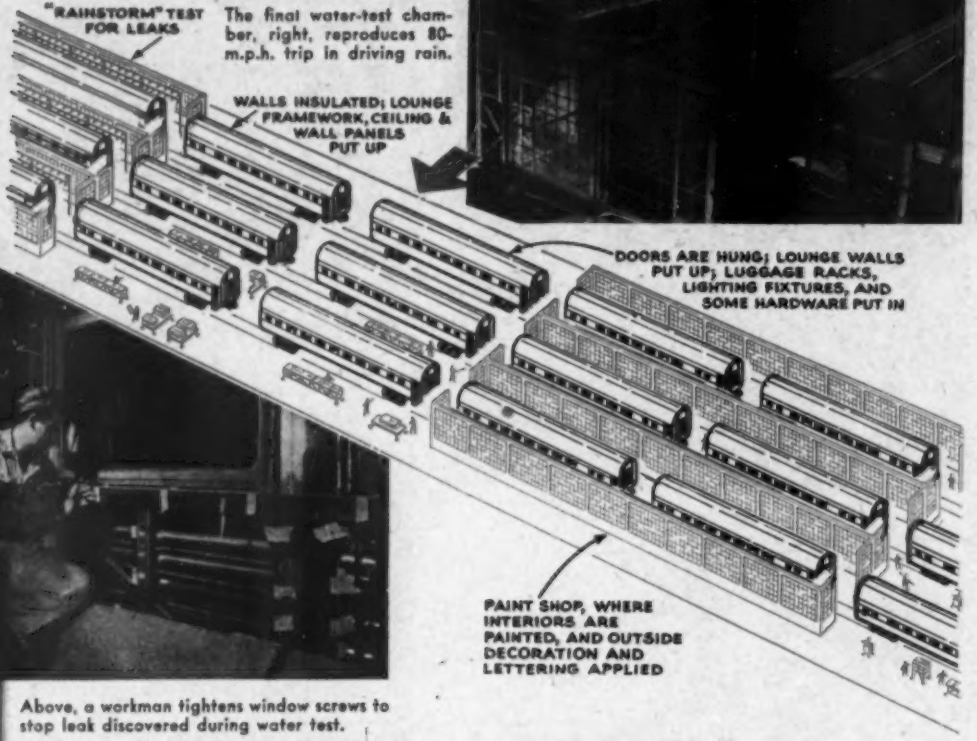
At right, the motor-propelled drawing head pulls the stainless steel ribbon through roller dies. Corrugated jaws grip end of steel.



Drawings by STEWART ROUSE



At left, underframe is upside down for installation of auxiliary equipment such as air brakes, heaters, plumbing. Arc welding does the job.



The final water-test chamber, right, reproduces 80-m.p.h. trip in driving rain.

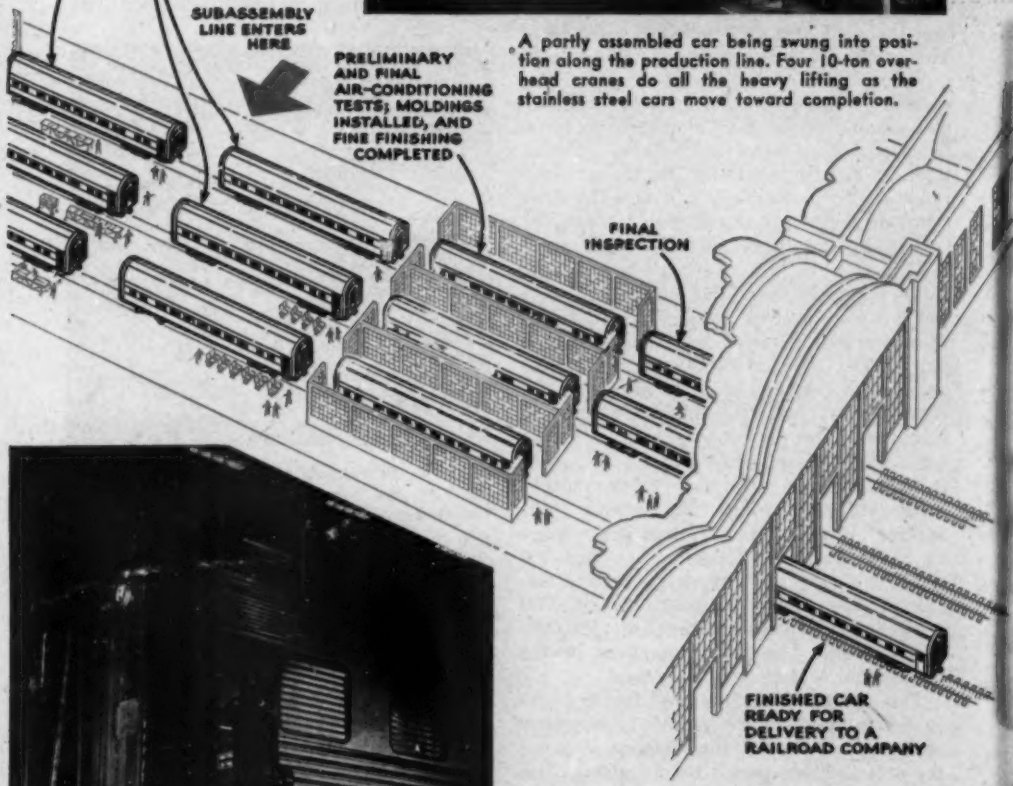
Above, a workman tightens window screws to stop leak discovered during water test.

At left, a shot welder joins a side frame to an underframe at the first main assembly position, where skeleton car is formed.

Below, assembled car is set on temporary raised trucks before side paneling and fluting are applied.

PSM Staff Photos by W. W. MORRIS and ROBERT F. SMITH.

A partly assembled car being swung into position along the production line. Four 10-ton overhead cranes do all the heavy lifting as the stainless steel cars move toward completion.



At left, the permanent trucks are being installed. Heavy-duty jacks are used to raise the cars into the required position for the job.

cago, Burlington, and Quincy's "Pioneer Zephyr," was built by Budd in 1934. Up until the beginning of the war, when all railroad-car production stopped, Budd had built and sold 47 complete trains to 14 railroads. So the firm is an old hand at this big job.

Budd-built railroad cars—except for their trucks, end underframes, and miscellaneous decorations and fittings—are made entirely of welded stainless steel. By a method of electrical stitching, called "shot welding," strips and sheets of stainless steel literally are "sewed" together with rows of uniform spot welds.

Shot welding, a Budd development first used in 1931 to produce the first stainless steel airplane, is a form of electrical-resistance welding. Time and the current, and therefore the heat, are automatically controlled. The result, according to Budd engineers, is a strong weld that changes none of the characteristics of the surrounding metal, and that can be made just about as rapidly as the operator can move his U-shaped welding tool. In the course of the production of a railroad car, more than a dozen different types of shot welders are used, ranging in size from a few feet in length to fifteen.

This combination of strong welds and stainless steel gives Budd cars a heavyweight's strength with a welterweight's body. In a recent test, Budd research engineers placed a standard 118,000-pound stainless steel coach between the jaws of one of the world's most powerful compression-testing machines. The project was to squeeze the car along its main fore-and-aft axis until it buckled in much the way that it might in a head-on wreck. The "big squeeze" was applied slowly so the stresses and strains could be studied. Finally, when the first signs of buckling appeared, the testing machine's gauge showed a pressure of 1,865,000 pounds—more than three times the 500,000-pound standard for safety required by the Association of American Railroads!

Part of this strength is built into the cars at the beginning of the assembly line where, at the No. 1 feeder, the stainless steel for the roof and side panels is corrugated. This work is done by a battery of large draw benches similar to the benches used in drawing wire except that the material is flat instead of round. The ribbon of flat stainless steel is pulled through a series of powerful roller dies until just the right corrugation is obtained to provide maximum stiffness. When a desired length has been drawn, the corrugated sheet is cut off with a toothless Carborundum saw, called a radiac. Except for the cutting operation, the drawing is a continuous process. When one roll of stainless steel is used up, the end of a new roll is welded to it. A novel rolling welder is used for this operation. A metal welding wheel is simply rolled across the joint and the weld is made.

The center sill or main under backbone of the car consists of four ¼-inch formed sections of stainless steel. After being drawn to shape, the sections are moved to an assembly jig where, once they are clamped firmly in place, a motor-driven "walking welder" resembling an animated drill press moves along the assembly and automatically makes the more than 3,000 individual shot welds that bond the section into a strong 58-foot-long beam.

Last step before final inspection is cleaning and polishing the completed car. Note the easily turned lounge seats in this coach.

Once the roof and side panels and the center sill are ready, the main assembly job begins. The center sill is placed in still another jig where a "silent riveter"—a king-size pair of hydraulically operated jaws—squeezes rivets into place easily and noiselessly with its 50-ton pressure to fasten the end underframes to the ends of the center sill. This complete underframe unit is then moved by overhead crane down the line where floor beams and floor are welded into place.

While this operation is in progress, complete car roofs are being fabricated, water-tested for leaks, insulated, soundproofed,

and fitted with wiring and air-conditioning ducts. To make it easier for the workmen and to speed the operation, all work done on the inside of the roof is done with the roof upside-down. This is also true of the installation of air brakes, plumbing, heaters, generators, and other equipment on the underside of the floor and underframe assembly. When a roof or a floor is complete with auxiliaries, four 10-ton cranes maneuver into position 100 feet overhead pick up the member as if it were a toy, turn it over in mid-air, and deliver it right-side-up to the first main assembly position. There, roof, side frames, ends, and underframe meet and are shot-welded together to become a skeleton car. Mounted on temporary trucks, which are elevated to make under-the-car work easier, the car then begins its step-by-step progress down one of three pairs of railroad tracks that form the final assembly lines.

From that point on progress is rapid. The cars literally grow as they are moved from position to position along the tracks by portable electric winches, and different teams of expert craftsmen go to work. Stainless steel fluting and side paneling are added. Doors and windows are installed. They enter a special water-test chamber where for two hours they are sprayed with water at 45-lb.-per-sq.-in. pressure to simulate the conditions of a car speeding through a driving rain at 80 m.p.h. Interiors are installed and painted. Linoleum floors are put in place. Permanent trucks are jockeyed into position and mounted with the help of hydraulic jacks that can lift the end of a car with less effort than you can lift the front of your automobile with a bumper jack. If the car is a coach, seats are installed. Then, entering another test chamber farther down the line, the car's air-conditioning system is given a thorough two-hour check to make sure that everything is functioning properly.

Finally, the car is cleaned, preened, polished, and inspected. The next stop is a spur track just beyond the large sliding doors that mark the end of the "line" where a waiting switch engine takes it to the main line for delivery to one of the 16 national railroads who have coaches, sleeping cars, and double-deck observation cars on order for the comfort and pleasure of America's railway travelers.

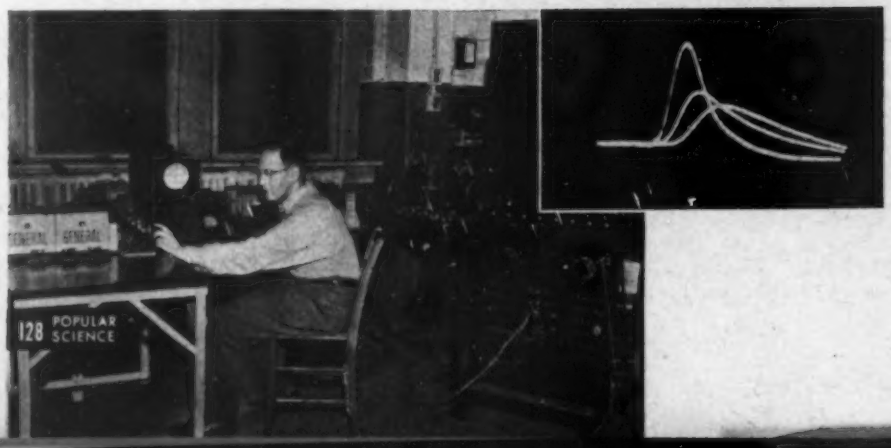
A finished 52-passenger coach, built by Budd for the New York Central. Coach has just been towed off the end of the assembly line and is on spur track outside the plant. Note large picture windows.

From a hundred feet up in the building's roof, the plant resembles a giant's bakery—with railroad cars for loaves. It has a giant's capacity too. Fifty-one 85-foot cars can be in progressive stages of assembly in the three lines at once. Soon a fourth will be added to produce a double-deck observation car. Today, full production is almost entirely a matter of getting in materials and getting up to speed. When it is reached, stainless steel in rolls stacked at one end of the plant in the morning will find itself eight hours later, wrinkled, welded, and part of a smart new 56-passenger streamlined coach or an ultramodern all-bedroom sleeping car, well on its way down the assembly line. END

Spotlight Shines Half a Mile. Four times as strong as a car headlamp, the new Westinghouse sealed-beam spotlight has a half-mile range. Built for autos and boats, its highly efficient parabolic reflector and parasol-shaped filament produce a glareless ray.

Magnet Concentrates Pull. By winding a U-shaped iron core with 6,000 turns of square copper wire, Dr. J. E. Goldman, of Westinghouse, has built a ton-and-a-half electromagnet (right) that packs enough strength in a space the size of a saucer to lift a two-ton auto.

Electricity Computes Floods. To learn the ways of floods, Ohio State University assembled the apparatus below, in which electricity acts like the water in a river channel. Elements in its circuit represent river-bed friction and the channel's capacity. Oscilloscope readings (inset) allow flood crest measurements.



Bifocals Blackout Bulls. Farmers know a bull won't charge when he can't see. The Masbruch halter above, produced by the Russell Mfg. Co., Platteville, Wis., lets a bull walk and graze, but when he lowers his head to charge, his vision is blocked.

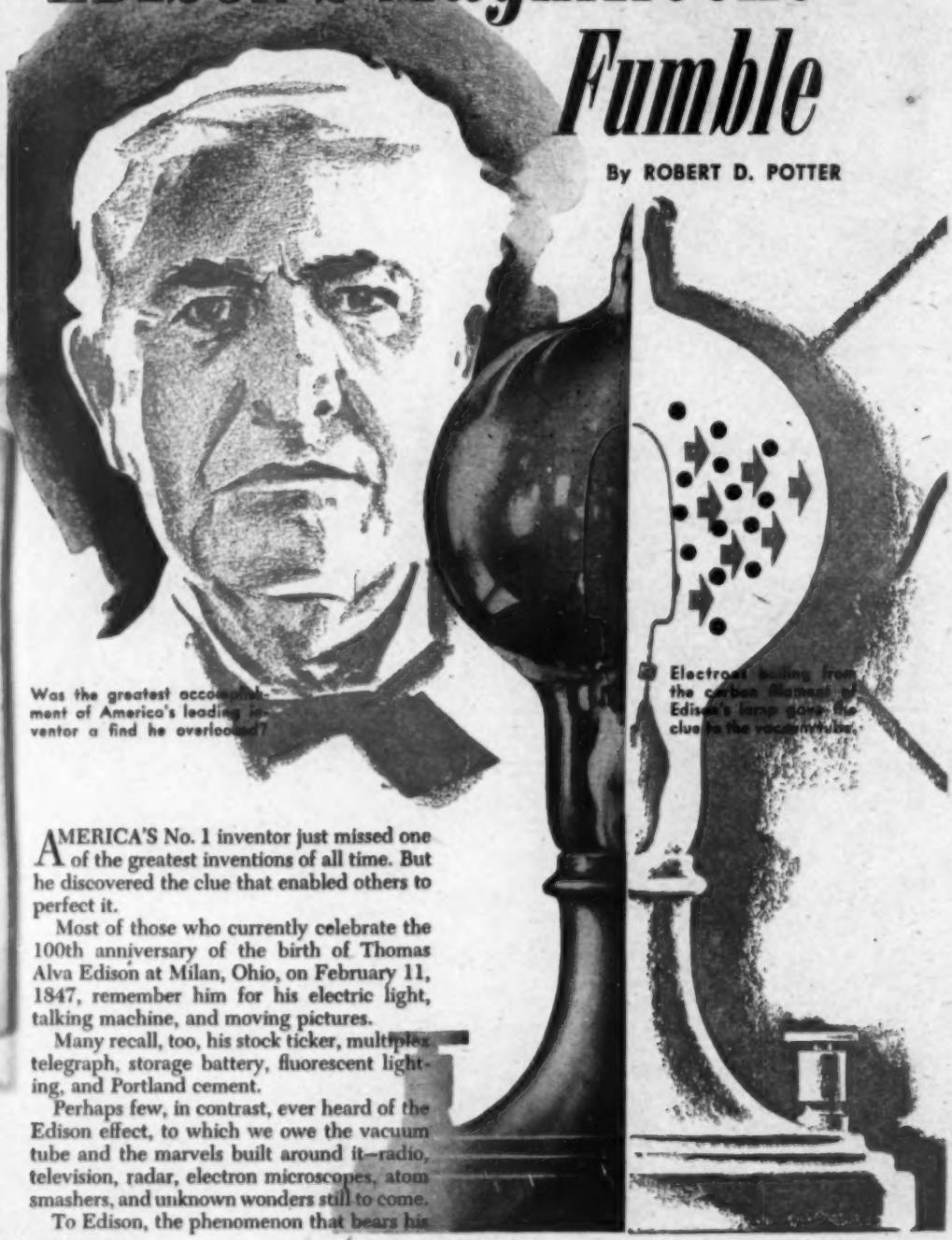
Latest Rural Head Lines

Horse Specs. Now come goggles to protect the eyes of race horses from mud clots and dust kicked up by their running mates. The specs are made by setting two Plexiglas bubbles into a regular set of blinkers. Showing off a pair, above, is Royal Hustle, first thoroughbred to wear them.

Kindly Weaner. Consisting of metal tabs that close over a calf's mouth when it raises its head to nurse, the Shur-Way weaner, left, prevents injury to the mother cow and breaks the calf of its habit without punishment. Yet in no other way does it curb the calf's freedom or keep it from feeding.

EDISON'S *Magnificent Fumble*

By ROBERT D. POTTER



Was the greatest accomplishment of America's leading inventor a find he overlooked?

Electrons boiling from the carbon filament of Edison's lamp gave the clue to the vacuum tube.

AMERICA'S No. 1 inventor just missed one of the greatest inventions of all time. But he discovered the clue that enabled others to perfect it.

Most of those who currently celebrate the 100th anniversary of the birth of Thomas Alva Edison at Milan, Ohio, on February 11, 1847, remember him for his electric light, talking machine, and moving pictures.

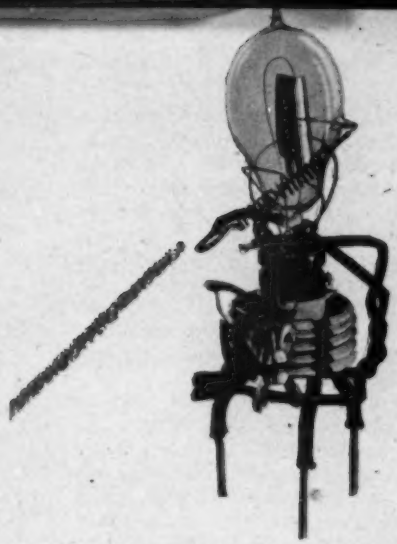
Many recall, too, his stock ticker, multiplex telegraph, storage battery, fluorescent lighting, and Portland cement.

Perhaps few, in contrast, ever heard of the Edison effect, to which we owe the vacuum tube and the marvels built around it—radio, television, radar, electron microscopes, atom smashers, and unknown wonders still to come.

To Edison, the phenomenon that bears his

Descendants of the two pioneer vacuum tubes have transformed our lives and language. "Wireless" of Marconi's time evolved into radio, is now frequently given the more precise name of AM or amplitude modulation.

AM



Fleming's diode tube of 1904, above, harnessed the Edison effect to change alternating current into direct current. Employed as a detector of ether waves, it opened the way to modern radio.

De Forest inserted a grid between filament and plate of his audion tube, below, and the radio amplifier was born. Feeble signals applied to the grid start and stop the flow of a stronger current passing through the tube.

FM

Static-free FM, or frequency modulation, now challenges the supremacy of the older system of broadcasting. And, some day, both AM and FM may be outmoded. But the basic principle they apply—the Edison effect—lives on.

name was no boon, but an unmitigated nuisance. Back in 1883, the Wizard of Menlo Park was fretting over his electric lamp. It burned brightly for a time, then sputtered and went out. Its bulb blackened. Something was carrying the very substance of the filament across empty space to the glass.

Edison inserted a metal plate in a lamp bulb, and attached a current meter. Its needle swung. Jotting down his observation, the busy inventor hastened away to other experiments of more obvious practical importance. Had he only known it, he had in his grasp the key to the whole vast science of electronics. For the meter proved that the filament was "boiling off" charged particles—electrons, we call them now. And they would flow in only one direction, from the filament to the plate.

More than two decades later, a British physicist, J. Ambrose Fleming, awoke to the significance of this Edison effect. It provided, he realized, a one-way valve for converting alternating into direct current. Embodied in his diode or two-element vacuum tube of 1904, it supplied the practical means of detecting wireless waves that the world had been waiting for. In 1907, Dr. Lee de Forest added a third element—a grid to control the current flow between filament and plate—and obtained, in his triode or audion, an amplifier that augmented the volume of faint reception until it could be clearly heard. Listeners took off their earphones—and wireless, given new ears and voice, became modern radio.

Just as truly as Fleming's diode and de Forest's triode became the main branches of the mighty family tree of electronics, so the Edison effect gave root to it. In a very real sense, the major types of vacuum tubes shown with their applications on these pages are Edison's unwitting brain children—and his greatest claim to fame may well be the discovery of a principle that will live on, even after all the inventions he made himself have been superseded by later developments and have passed from memory.

Striking a metal target, cathode rays generate X-rays used to make radiographs of human bones, treat cancer, and examine steel for flaws.

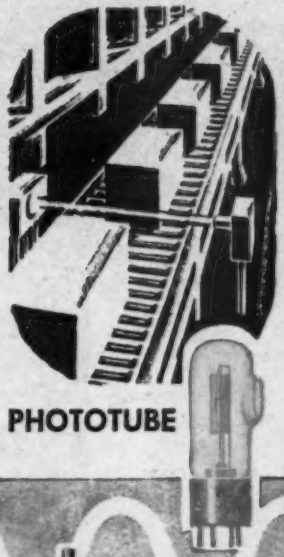
First applied in diathermy, high-frequency radio waves of pliotron tube now heat-treat steel for gears and tools and bond the layers of plywood.

Radar, which spots war targets and aids peacetime navigation, uses klystron tube to bounce signals against planes, ships, mountains—and even the moon.

Television cameras and receivers attained quality definition when weightless beam of cathode-ray tube ended speed limits on scanning.

CATHODE RAY

Photoelectric tubes count people, cars and factory products, open doors, make sound movies, and transmit copies of messages and pictures.



PHOTOTUBE

Electronic precipitation abates smoke by attracting particles to plates connected with kenetron tubes, which provide a high-voltage source.

KENETRON

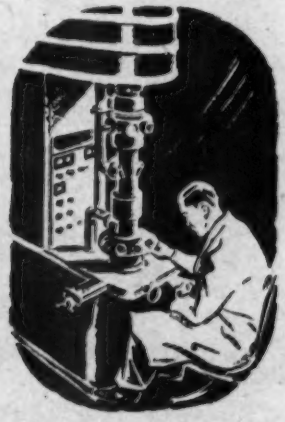
THYRATRON

The thyratron, a versatile tube, can handle large current output for welding, and serve as a "slave" to take orders from phototubes.

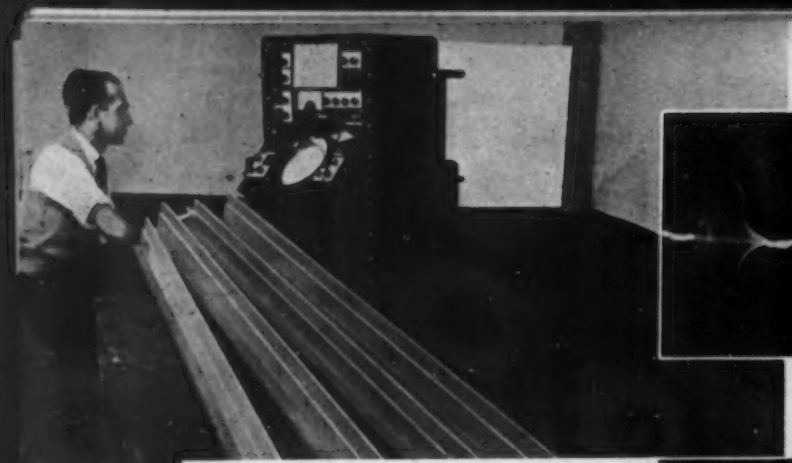
IGNITRON

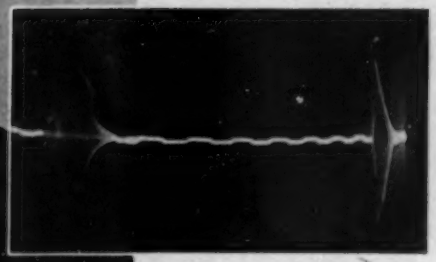
Ignitron tubes have two major functions—to turn alternating into direct current, and as a timing and switching device for arc welding.

ELECTRON MICROSCOPE



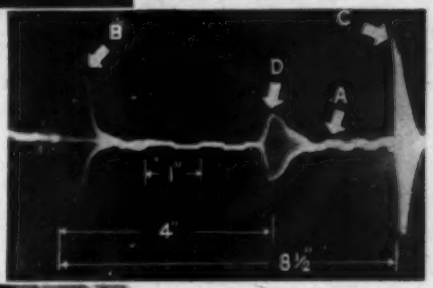
Allowing the men of science to probe deeper than they ever did before, the electron microscope is capable of magnification up to 180,000 diameters.





Reflectoscope line, above, shows sound metal. Below, A is zero sweep line.

Vibrations Expose Flaws. By bouncing vibrations from one side of a piece of metal to the other at supersonic speeds, the Sperry reflectoscope detects flaws and indicates exactly where they lie. With it, industry can study freshly milled plates and hunt for fatigue cracks in working parts of machinery and other equipment used in a plant.



B, above, is the initial pulse; C is its reflection. Reflected vibration, D, discloses a defect about four inches from surface.

Electrons Test Surfaces. Electrons, accelerated by a 40,000-volt electrostatic field, rebound from the target in a diffraction pattern on a photographic plate in the GE "camera," above.

Meter Measures Roughness. To test rubber sheets for roughness, the U. S. Rubber Co. uses a "rugosimeter," below. It measures the resistance to compressed air between a surface and a plate resting on it.

Rockets *Soup Up* British Bike

A CROWD of 90,000 saw Bill Kitchen (right), noted British motorcycle racer, smoke up Wembley speedway in London recently (above) on the world's first rocket-assisted motorcycle.

Prof. A. M. Low, rocket pioneer, and Alex Jackson, manager of the Wembley track, developed the rocket-boosted bike. The additional power is supplied by four rockets fixed over the rear wheel, two to the side. Kitchen was protected from the blast by a steel shield. Switches on the handle-bars controlled the rockets. The race rider said the "acceleration was absolutely terrific" when the rockets let go.

Dr. Low (right) and Jackson look over their rocket bike. Low plans an all-rocket-driven cycle this year.

AIDS TO MODERN LIVING

BASTING MEATS AND FOWL is just one use for a kitchen gadget marketed by the American Merchandise Distributors, of Chicago. Resembling an oversized medicine dropper, it also can be used to skim cream from milk, trim cakes and pastries, and water plants. The rubber bulb slips off the heat-resistant glass tube for cleaning.

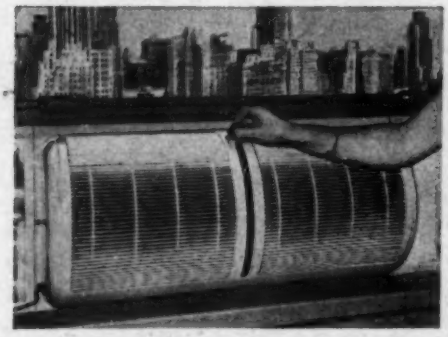
SCISSORS SHARPENING can be done at home with a small sharpener produced by the South East Merchandise Co., of Lynwood, Calif. A flat guide, placed against the scissors blade, brings a silicon carbide stone to the angle needed to produce a perfect cutting edge. The stone may be turned to a new side when one is worn.

VENETIAN BLIND TAPES may be replaced in only a few minutes without removing the blind from the window or disturbing the cord. This is possible by using tapes produced by Easy Way Tapes, of Cincinnati, Ohio. Equipped with a simple fastening device, the tape is slipped over the ends of the slats, the old one is cut off, and the new one is then moved into the proper position. No tools are required to do the job.

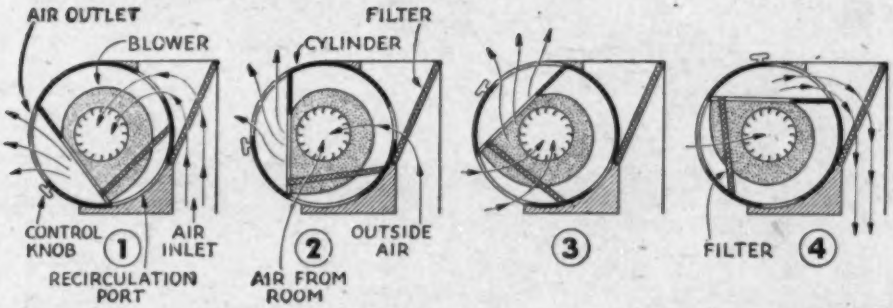
ICE-CREAM STICKS may be frozen in the home refrigerator with an aluminum mold manufactured by Standard Products Co., of Detroit. Several wooden sticks are provided with each mold and more may be purchased separately. The molds are placed in the freezing compartment and the frozen treat is ready in the time it takes to freeze ice.

A FURNACE LIGHTER manufactured by the Lorain Furnace Lighter Co., of Lorain, Ohio, eliminates the need for kindling of any kind in starting a fire. The lighter, a gas burner connected by a hose to an outlet, is lighted and thrust into the ash pit after the firebox has been charged with coal or other fuel. The hot flame, thrown upward through the grate, is said to produce a blazing fire in only a few minutes.

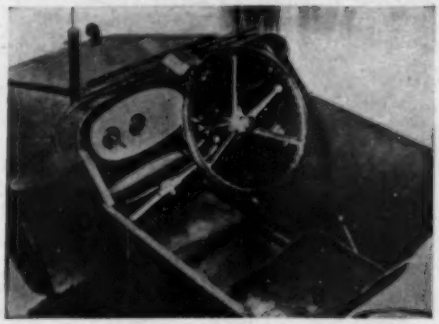
WHETHER THE SHOE FITS is quickly seen when you buy shoes for a child in a store equipped with the "Window Fit" system, developed by Step Master Shoes, Inc., of Greenup, Ill., and displayed as above. Instead of measuring the foot, or relying on guess work, the clerk slips a master fitting shoe, made mostly of clear plastic, on the child's foot. Parents then can see for themselves how it fits. With the size determined, new shoes are selected from stock.



ROOM VENTILATION in any one of four ways is provided by a new window ventilator manufactured by the U. S. Air Conditioning Corp., of New York. As illustrated below, an electric blower draws fresh air from the outside (1) when the control knob is set at the bottom position. Move the knob up to the next position (2) and room air is recirculated and mixed with fresh air. Move it again (3) and you get full recirculation of room air. Last, (4) the ventilator serves as an exhaust to remove stale air from the room. Air volume is regulated by a rheostat.



AUTO IDEAS



All controls in this British midget are located in the usual positions, but each can be adjusted for hand or foot operation by a disabled person.

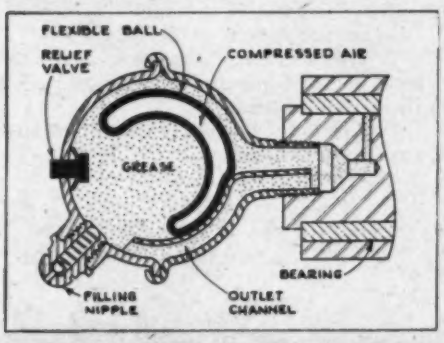
A SINGLE-SEAT CAR now being produced in England was designed especially for disabled persons. Clutch, brake, and throttle can all be arranged for either foot or hand control to suit individual requirements. Known as the Larmar, the four-wheeled car has a 2½ hp. engine, located at the rear. It cruises easily at 35 m.p.h. and travels approximately 65 miles on a gallon of gasoline.

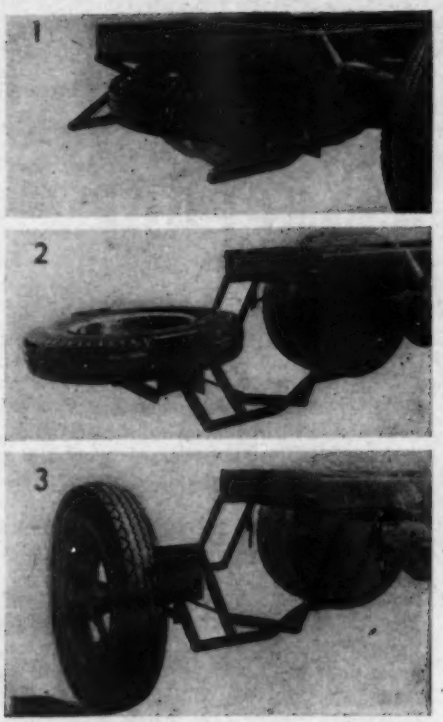
Three forward speeds are provided, but there is no reverse, since the car, which is approximately 7′ 6″ long and 2′ 4″ wide, can be turned in a 15′ circle. The wheels, fitted with 4.00 by 16 tires, are independently sprung and each has a cable-operated, internal-expanding brake. An extra wheel and tire are carried in the large luggage compartment located at the front of the car.

RELEASE THAT BRAKE! A dashboard signal light developed by the Eklind Tool & Mfg. Co., of Chicago, is intended to prevent motorists from driving with the parking brake on or only partly released. Easily installed on any car, the light flashes a brilliant red as soon as the ignition is turned on and continues to burn until the brake is fully released. The red cap may be removed to give a bright light for reading notes and maps. As seen below, the light consists mainly of three zinc castings.

BRAKE ACTION AND PICKUP of a car both are measured by a pendulum-type accelerometer produced by the Metron Instrument Company, of Denver. Using the same force that tends to throw a motorist forward or backward when the car stops or starts, the instrument requires no electrical or mechanical connections. Mounted on the windshield molding, it gives a constant performance check.

GREASE FITTINGS produced by the Simplex Mfg. Co., of Detroit, are intended to supply bearings with a continuous flow of lubricant for long periods of operation. A neoprene ball inside the cup is compressed when lubricant is forced into the reservoir with a hand or power gun. Then, as the bearing needs grease, pressure exerted by the compressed air within the ball forces the lubricant inside.





CHANGING A TRUCK TIRE is less of a physical strain with a Ted Tire Carrier, put on the market by the T.E.D. Corporation, of Los Angeles. As seen above, the carrier is bolted to the chassis frame. When the holding clamps are released, the carrier swings out and tilts so that the tire is ready to be detached and rolled away. The carriers are available in two sizes.

LUNCHING IN A CAR usually brings up the problem of a convenient place to rest the food and drink while you are eating. As a solution, the Kar-Tra Distributing Company, of Atlanta, is offering an aluminum tray which attaches to the dashboard and folds back out of the way when not in use. Polished to a fine finish, the tray measures 9" by 12" and has a raised edge to prevent objects from sliding off. Supporting the tray are an arm and two adjustable ball sockets that make it possible to raise the tray to a convenient height and level it regardless of the car angle.

GUS Slows a Speeder

By MARTIN BUNN

A LOT of folks have lived in this town all their lives without knowing or caring that the small, vacant warehouse north of the railroad station belongs to Mrs. Pomfret, perhaps because she owns so many things she needs two lawyers to keep track of her dividends.

But Peter Evans, the new pastor who took over when Dr. Hatch retired, wasn't in town three weeks before he knew all about the building and had a plan for putting it to use. The Rev. Mr. Evans had been selected for this post while he was still an Army chaplain; in no time at all he had people applauding his scheme for establishing a young folks' community center. The whole idea hinged on whether Mrs. Pomfret could be talked into contributing the idle warehouse.

Officer Tom Maloney, a burly, usually cheerful man, had one way of looking at it. He paused outside the Model Garage one morning to greet Gus Wilson with a wan, unhappy smile.

"Why the long face, Tom?" asked Gus. "Can it be you don't know our school basketball team got nosed out of the county championship by Remsen High? Meaning no reflection on the school, our small, overcrowded gym is no proper place for a good team to practice. It'll be a different story next year when Mr. Evans makes over a floor for the use of our teams."

"That ain't all," put in Stan Hicks, Gus's young grease monkey. "I spent a week's pay taking my girl out Saturday night. Now, that recreation hall—"

"How's it coming?" Gus inquired. "I haven't heard that anything's been settled."

Tom shook his head. "There'll be willing hands to make the repairs once Mrs. Pomfret agrees, but there's no telling with her."

"Crazy as a beetle," Stan agreed emphatically. "Remember the time she got mad when I blew a horn in front of her house 9:30 at night? Took away her repair business because you wouldn't fire me."

"I wasn't sorry to lose it," Gus declared. "A new chauffeur every week, and every one of them begging me to make her bus less peppy. I hated to see that fine car start up like a wet sponge bouncing off a sofa pillow!"

"That's my worst worry," Tom grunted. "It has come to my notice that Mr. Evans is addicted to speeding and fast starts."

"That could make trouble," Gus agreed. "Has anyone spoken to him about it?"

"I have, for one. He says his car has too much pep. Had it tuned up before he left Denver a month ago."

"Denver, eh?" Gus asked with fresh interest. "I worked there years ago."

"He was stationed near there. Look!" Tom waved his club toward the corner, where three cars glided to a stop before a red signal. "That's him, now. The blue sedan on the far side."

The light clicked orange, then green, and Mr. Evans' car promptly shot forward ahead of the others.

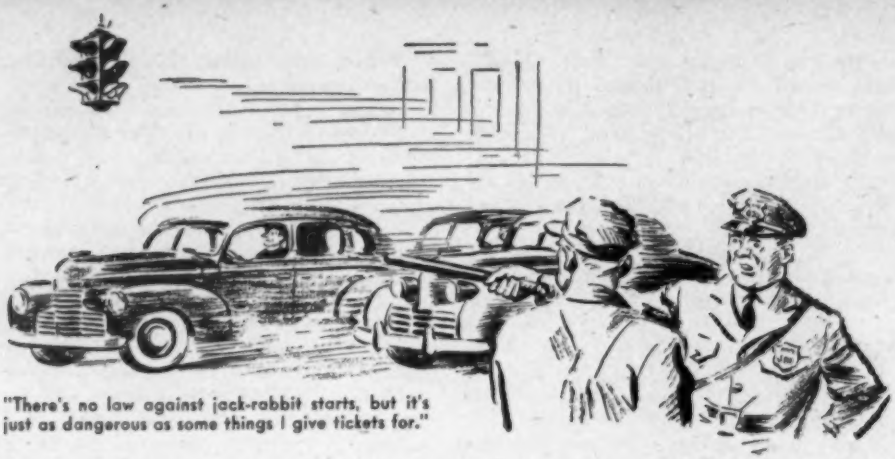
"See?" Tom snorted. "There's no law against jack-rabbit starts, but it's just as dangerous as some things I give tickets for."

PURE chance, in the form of a stalled car, made Gus a witness to the next round in the Evans-Pomfret match. At about four o'clock that afternoon, he was summoned to Regent Street, the high-toned avenue where our few wealthy families live. He had just finished putting in a new fuel pump when he caught sight of Mr. Evans' car easing slowly toward the Pomfret driveway across the street. Behind the smiling young pastor sat stout, bejeweled Widow Pomfret, talking graciously at the young man's back.

As the sedan nosed over the curbstone, a spotted dog cavorted dangerously toward the wheels, and the driver jammed on the brakes just in time to avoid hitting it. The dog hastily changed his course and bounded up the drive, while Mrs. Pomfret, thrown slightly forward, clutched the seat in panic.

Apparently the young man was able to reassure his passenger, for she craned her head to see the dog. Nervously the driver hunched over the wheel and clashed into first. From a dead stop the car shot forward like a rocket being launched. Mrs. Pomfret was flung against the cushions, her face blanched and terrified. It took a moment to recover her breath, and then it was to utter an ear-piercing shriek.

"Murderer!" she screamed. "You did it on purpose!" With surprising agility, she flounced out. "Don't bother," she shrilled, ignoring Mr. Evans' attempts at apology.



"There's no law against jack-rabbit starts, but it's just as dangerous as some things I give tickets for."

"I'm not interested in anything you have to say! And as for the warehouse, I'd sooner see it burn down than give it to you!"

JUST what I feared," groaned Officer Maloney, when Gus recounted the scene to him the next morning.

"I've been thinking," Gus went on, "that this is right in my department. Could I have a look at his car?"

"That you could," thundered the policeman. "I'll get it down to your shop if I have to give him a ticket."

Whether he would have done such a thing is doubtful, for Tom Maloney looked embarrassed rather than official as he escorted the Rev. Mr. Evans into the Model Garage.

"We've got an awful nerve butting in on your business," said Gus, shaking hands with the big young pastor, "but if your car's been causing trouble . . ."

"I appreciate your interest," Mr. Evans boomed cordially, "but there's nothing wrong with my car, so it must be me."

"Too much speed isn't usually a trouble."

"It is for me," the pastor replied ruefully. "My car has pretty snappy pick-up, but I can usually keep the speed down. Sometimes, though, I get preoccupied, and the next thing I know I'm sailing along like a high wind."

Gus pondered. "It might be the car. How did it behave when you first got it?"

"I didn't notice that it had more speed than other cars. Not till I was driving back East, at any rate."

"Mind if I look?" Gus asked.

"Of course not." He dug the keys out of his pocket. "It's right outside."

Gus got into the blue sedan, started and stopped it a few times, then drove it into the shop, and got out. "Ever hear of a Denver head?" he asked, peering down into the engine.

Mr. Evans and Officer Maloney both pondered and shook their heads in unison.

"Denver is about a mile above sea level," Gus explained, straightening up and dusting his hands. "Up there a regular seaboard engine with a compression ratio of 6 to 1 loses about a quarter of its rated power. To compensate, dealers shave down engine heads to increase compression to 7 to 1 or more. Your car is equipped with one of those Denver heads, and here, at close to sea level, it gives faster pickup and a higher top speed. Of course you don't get that extra power for nothing—you have to use better gas to keep the motor from knocking, and the plugs don't last as long."

Mr. Evans laughed. "So that's what's been making a speed demon out of me!"

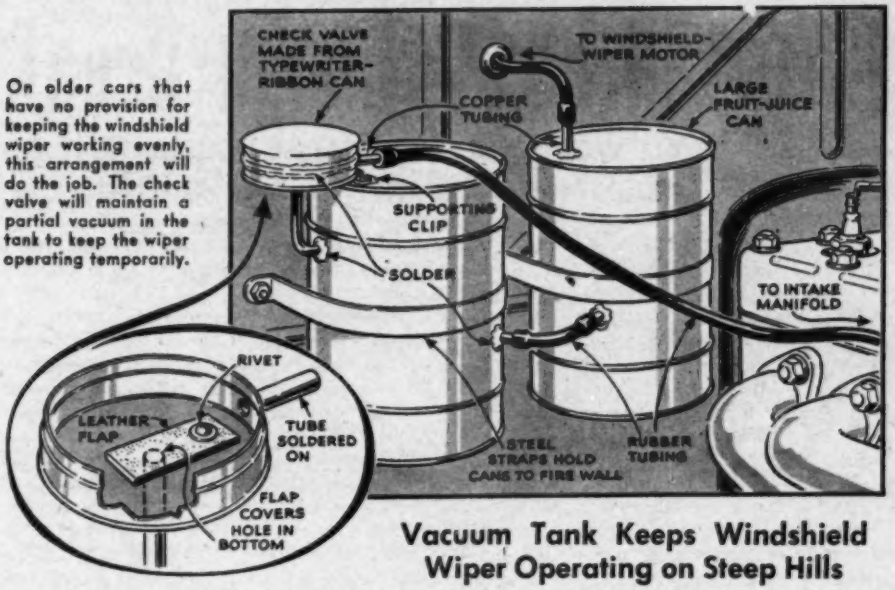
"In a way," Gus went on. "You see, a month or so of fast starts has also caused your clutch to grab. That, combined with the higher compression, is bound to result in jack-rabbit getaways any time you're forgetful or something happens to disturb your timing."

"Can anything be done about it?"

"The best idea might be to install extra head gaskets to cut down the compression. It will be better for the car and tires. And maybe Officer Maloney will stop thinking you're a traffic hazard—not to mention Mrs. Pomfret."

"I'm afraid I'll have to do a lot of talking before she'll trust herself in my car again," Mr. Evans laughed sheepishly. "You go ahead and put in the gaskets. I'll hate to miss the fun of beating everyone in town at the traffic lights. But I guess our new community center'll be worth it."

On older cars that have no provision for keeping the windshield wiper working evenly, this arrangement will do the job. The check valve will maintain a partial vacuum in the tank to keep the wiper operating temporarily.



Vacuum Tank Keeps Windshield Wiper Operating on Steep Hills

UNLESS equipped with a compensating valve, a windshield wiper will frequently slow down or stop whenever the throttle is opened up. This annoying and sometimes dangerous habit can be overcome by installing a tank and check valve in the wiper line to maintain a partial vacuum for the few seconds needed to keep the wiper working evenly during the slack periods. The tank should have a capacity of about 1 gal.

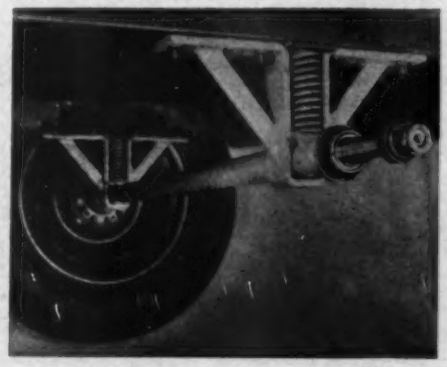
Two tall fruit-juice cans will give you approximately this capacity, and a check valve can be made from a typewriter-ribbon box. Cut two ¼" holes in each fruit-juice can at the points indicated, drain out the juice, and rinse with water. Solder short copper-tubing nipples in three of the holes and a longer L-shaped nipple in the one near the location of the check valve.

Two holes also are required in the check-valve can, one in the side for a nipple to accept the tubing from the intake manifold and another centered in the bottom to take one end of the L-shaped nipple. After the latter nipple has been soldered, remove any excess so that the leather flap valve will close tightly. Clamp the cans to the fire wall and connect the nipples with rubber tubing.

Axles for Homebuilt Trailers Have Coil-Spring Suspension

AXLES and spring suspension units are being produced by the Industrial Machine Tool Co., Inc., of Fenton, Mich., especially for craftsmen who want to build their own trailers. Of all-welded construction and manufactured of tubular steel, the axles are available in either the straight type or with 4" drop for most standard wheels.

Two coil springs are contained in each suspension unit, providing four springs per axle. Although assuring a positive cushion to the trailer load, this type of springing eliminates any rocking motion. The axles have the standard 58" tread, but wider ones may be obtained on special order.



Give Your BATTERY a Break

ALL WORK AND NO CHARGE WILL MAKE IT GO DEAD. HERE ARE TIPS TO PROLONG ITS LIFE.

By RICHARD W. CRANE

MOTORISTS sometimes literally work a battery to death. Perhaps they are careful to keep the electrolyte above the plates, but all too often responsibility stops there. They overlook the fact that unless the car is operated so as to keep the rate and periods of battery discharge at a minimum, the battery will have little chance of lasting long.

In this respect, judicious use of the starter is the most important point, for a battery expends more energy in cranking a car than in performing any of the many other jobs it is called upon to do. Here are five ways you can reduce this starter drain:

1. When possible, park on a hill and start the engine by coasting.

2. Depress the clutch while using the starter. This disconnects the transmission and lessens the load. On a sub-zero day, when the oil may be virtually a solid, this may determine whether you ride or walk. Even in warm weather, it will help.

3. To decrease the total load on the battery, shut off all other electrical equipment before pressing the starter button. A relay that is available commercially does this automatically, but you can do it by hand with little trouble.

4. In cold weather, use the light oil specified for your car. But if you are caught in a sudden cold snap with summer oil in the crankcase, it will help to pull out the choke just before stopping the engine. This should not become a habit, however, for it washes the oil from the pistons and cylinder walls.

5. Develop a technique for starting the motor when cold. If your car does not have an automatic choke, a little experimenting to determine the best choke and throttle settings will save a lot of battery wear. Generally, the choke should be pulled out all the way and the throttle slightly. When the engine takes hold, push the choke in as soon as you can without stalling the engine.

Some drivers habitually pump the accelerator while using the starter. This is unwise. For one thing, an open throttle increases the proportion of air to fuel, making the mixture leaner; and on cars having acceleration pumps, it may also cause flooding. However, on cars having such pumps it may help to push the accelerator several times to the floor *before* touching the starter, since this is a form of priming.

Next to the starter, the headlights are the largest user of battery power. While you may use them freely any time the generator is turning fast enough to compensate for the current drawn, they should be kept off as much as possible when the motor is idling or not running. When the battery is run down and you must drive at night, switch to the parking lights whenever the engine is idling, as while waiting for traffic lights.

On some cars the current the headlights draw does not go through the ammeter. Because of this, it often may appear that

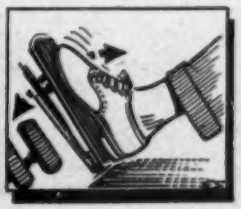
YOU CAN HELP YOUR BATTERY DO ITS BEST JOB. OPERATE YOUR

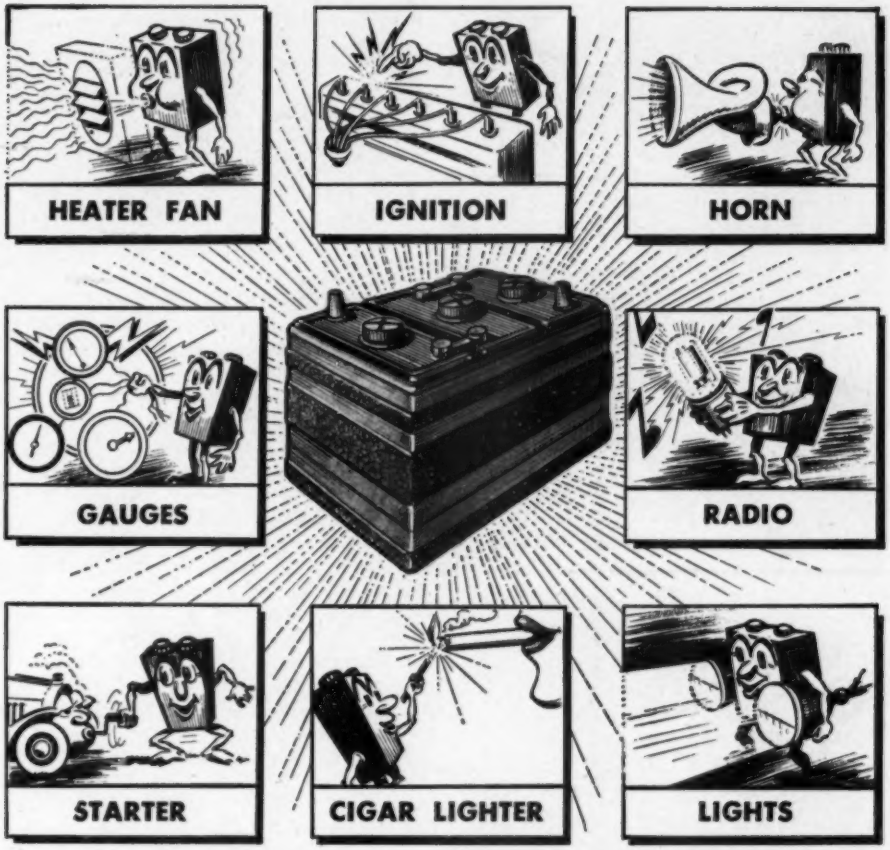
Use the right oil. If the oil is heavy, the starter takes more battery power.

When starting an engine, first turn off the lights and all accessories . . .

. . . Then adjust the choke (if it isn't automatic), and the hand throttle . . .

Next, pump the accelerator several times to prime the engine . . .





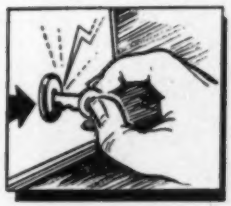
A BATTERY SERVES YOU IN MANY WAYS. BUT DON'T OVERLOAD IT.

the battery is being charged when it actually is discharging. Check your owner's manual on this point.

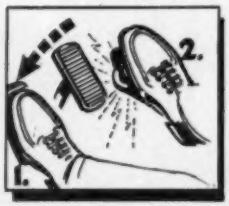
As for radios, heaters, fog lights, and other electrical accessories, it is a good practice to use them sparingly. Each alone may use little power, but lumped together they take a lot; and when, at night, this is added to the demands of the headlights, dash lights, tail lights, and ignition system, the total may be greater than the maximum generator output, especially on older cars.

CAR PROPERLY AND THE BATTERY WILL SERVE YOU MUCH LONGER.

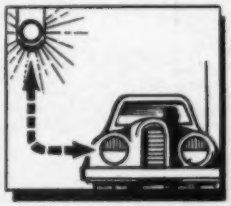
. . . And don't forget the ignition. (It's silly, but a driver often does) . . .



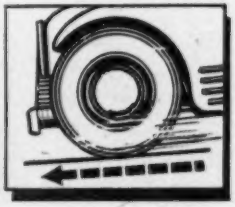
. . . Depress the clutch and you finally are ready to touch the starter button.



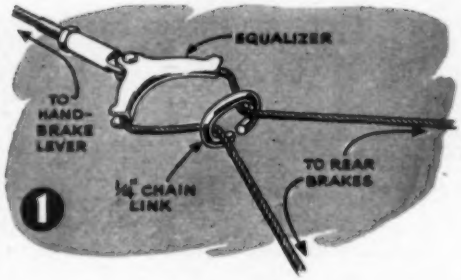
If your battery is low, switch to parking lights when held up in traffic.

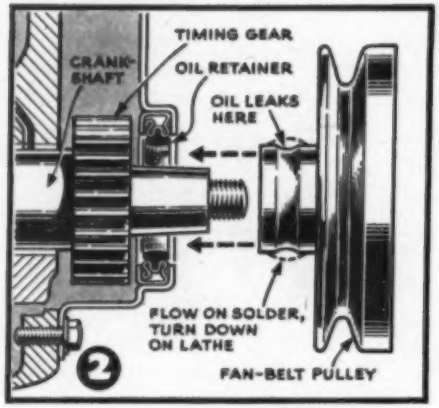


When possible, park your car on a hill and start the engine by coasting.



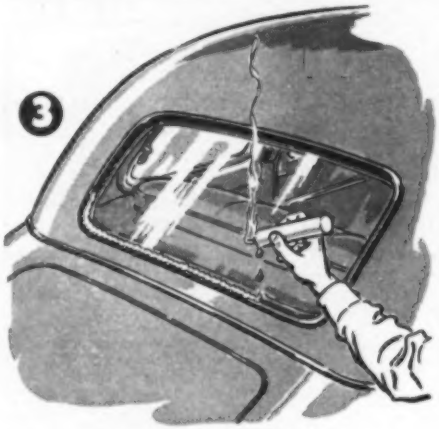
AUTO HINTS





1. HAND-BRAKE CABLE SLACK can be taken up when no more threads remain in the clevis by slipping a ¼" chain link over the cable near the equalizer. By pulling the cable together this provides 1" more of threads for adjustment. Use a replacement tire-chain link, and bend it closed after installation.—H. G. WEBER.

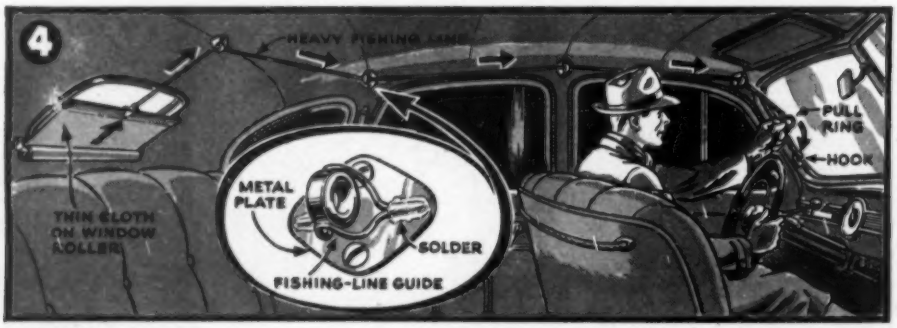
2. SOLDER ON THE WORN HUB of a fan-belt pulley will stop an oil leak when grooving by the oil retainer after long service has destroyed the seal. Build the hub up well with solder; then turn it down in the lathe, leaving it a little high to make up for wear on the retainer itself.—R. L. MCCLANNAN.



3. RAIN-LEAKING REAR WINDOWS and windshields can be plugged with wax dripped from a candle into cracks in the rubber seal. Drip the wax on for several inches on both sides of the breaks. Until the sun melts the wax thoroughly, the leak won't stop completely.—C. D. BASSETT.

Drawings by STEWART ROUSE

4. REMOTE REAR-CURTAIN CONTROL enables a driver to shut off glaring headlights from a car behind and to reopen the shade and restore rear-view vision when the car has passed. The pull cord is a heavy fishing line threaded through a series of casting-rod line guides on metal plates.



MECHANICS AND HANDICRAFT

- Your Own Copying Camera
- Aluminum Serving Tray
- Magazine Rack and Smoking Stand
- De Luxe Crystal Sets
- Fixing Balky Doorknobs

It Serves You Right

ALUMINUM-AND-PLASTIC TRAY HOLDS GLASSES AND ICE.

By Bill Luther

STAINLESS aluminum and clear plastic, both available as war-surplus stock, are combined to make this serving tray, which may be tailored to fit your favorite glassware. The base is of corrosion-resistant .080″ aluminum alloy, the feet and handles are round bar stock, and the upright spacers are tubing. An 11″ by 17″ sheet of ¼″ plastic is bored to receive the glasses and an ice container and to act as a guard.

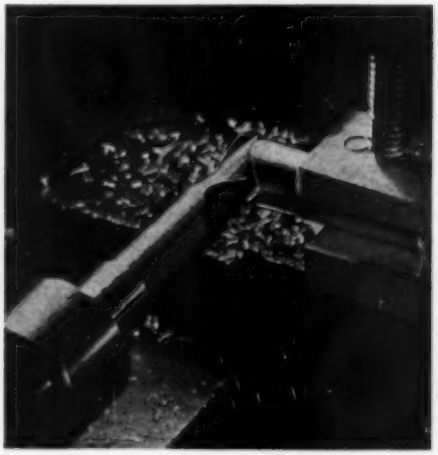
File the edges of the alloy smooth and round each corner slightly. Then, to impart a brushed finish and remove scratches and stamping, sand the best side with coarse sandpaper, taking all strokes evenly and lengthwise. Lay out and drill 14 No. 12 holes, remove the burrs, and wash thoroughly with hot water and kitchen cleaner, rubbing in the same direction as when sanding. Dry with a soft cloth, and from then on handle the piece by the edges to avoid finger marks. The bottom may be covered with cemented gray felt.

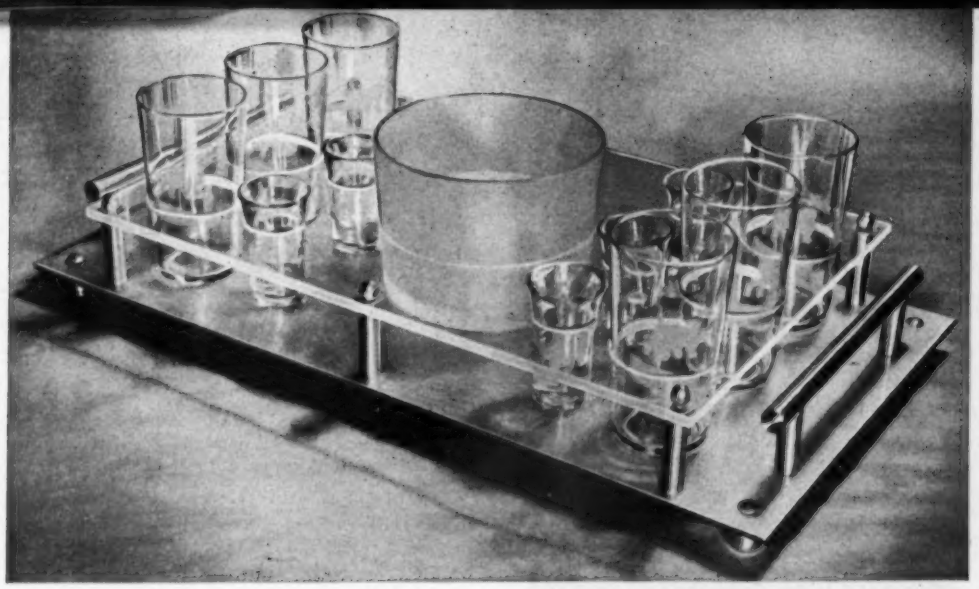
Turn the feet from 1″ diameter aluminum-alloy bar. Drill a No. 21 hole through each piece, tap 10-32, and counterbore for a depth of 1/16″ to take a disk of leather, cork, or rubber as a safeguard against scratching table tops. Cut two 8″ lengths of ½″ diameter bar for the handles, drill two blind holes radially in each, and tap also 10-32. The uprights supporting both the handles and the plastic shelf are cut from ½″ aluminum tubing. Make the handle spacers 1½″ long and cut one end concave with a ½″ end mill or round file to fit the handle. The shelf spacers are 1¾″ long.

Without removing the protective paper covering, lay out the clear-plastic shelf guard carefully for each piece of glassware to be used, taking the diameter of the pieces 2″ from the bottom. If the glasses are footed or otherwise larger at the bottom than at the point measured, the holes must be large enough to let that part through. Lay out also six screw holes at the corners and midway at the sides, marking through the spacer holes in the aluminum bottom as a pattern. Then, using a hole cutter in the drill press, bore a little beyond halfway

For a brush finish and to remove markings, sand the best side of the aluminum-alloy bottom with coarse sandpaper. Make even, lengthwise strokes to get a uniform finish on the metal.

Uprights supporting the handle rods are machined concave to fit the handle diameter. Here the job is done on the tubing with a ½″ end mill. A round file could have been used as well.

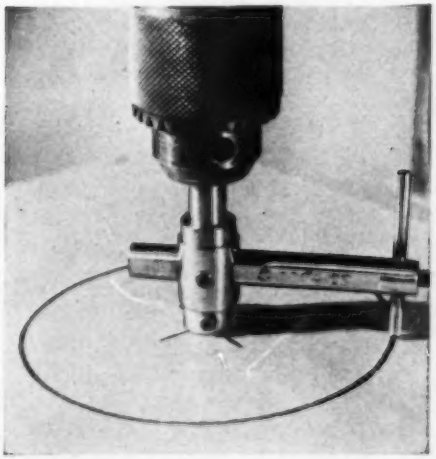


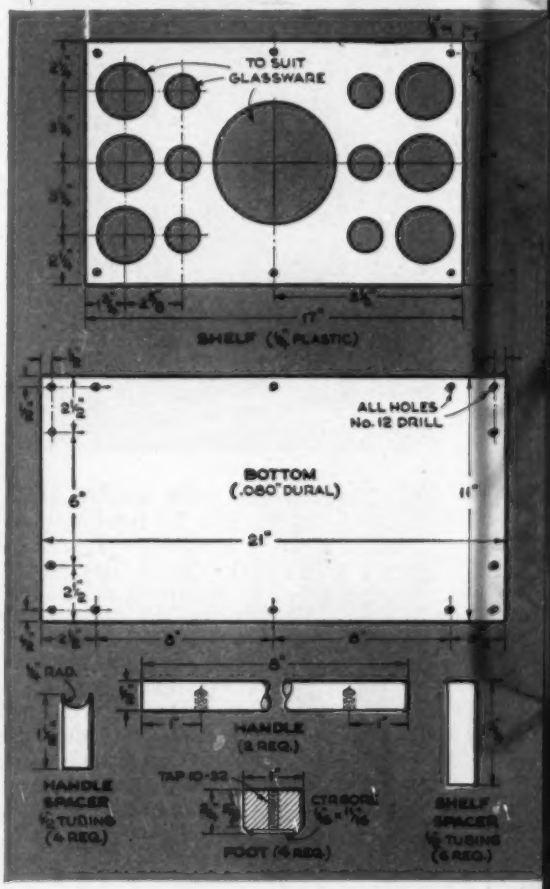


for the glass holes and finish from the opposite side to prevent chipping as the tool breaks through. Likewise drill No. 12 spacer holes first from one side and then from the other. Before removing the paper, wet-sand all edges smooth.

Assemble the parts with cadmium-plated buttonhead screws, washers, and hexagon cap nuts. Use 2¼" screws head down for the shelf, lining up the parts carefully, 1⅝" screws in the handles, and ½" screws in the feet. Glue protective disks on last.

Cutouts for the glasses are made in the plastic with a drill-press hole cutter. Half the cut is taken from one side, and the hole is finished from the other to prevent damaging the edge.

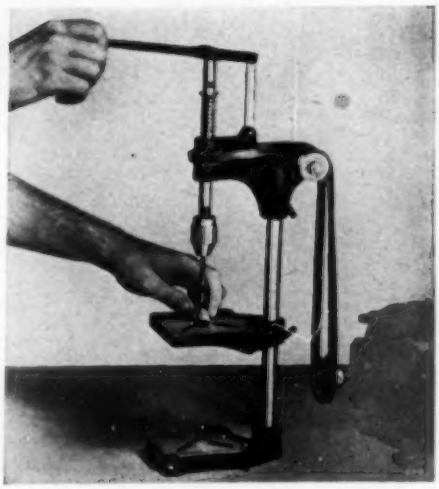




NEW TOOLS

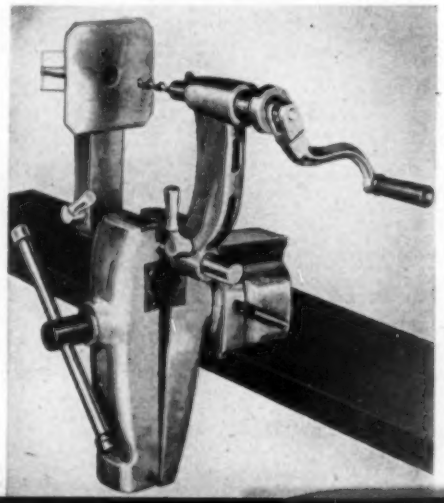
HAND TAPPER. Accurate duplicate work is accomplished with the tool shown below, for the adjustable arm can be raised and swung to the right or left without disturbing the setting of the taps. According to the manufacturer, the Viking Tool & Machine Corp., of Belleville, N. J., the tapper is five times faster than a wrench. Square alignment of the taps with the work in all positions is said to reduce tap breakage.

NEW GAUGE. Made by the Read Machine and Tool Co., of Los Angeles, this device measures the size of hex and square bolts and nuts, length of bolts and screws, threads per inch, diameter of rods and shafts, the pitch diameter of nuts, and hole and washer sizes. It is made of dural and stainless steel to cover ¼" to 1⅝" sizes and lengths up to 4".



MODELMAKER'S DRILL PRESS. This light-duty press, offered by Richter Tool Company, of New York, drills to the center of a 5⅜" circle and has a spindle travel of 2¼". The head may be raised to take up slack in the V-belt, and both the adjustable table and the base have a center hole and diagonal slots. Standing 23" high, the press takes up only 3½" by 10" bench space. A ¼"-capacity Jacobs chuck and pulleys are provided.

VISE AND DRILL. Two separate units are combined in one tool manufactured by W. H. Howland, of Chicago. Each unit can be detached and used individually as a portable tool, or the two together provide either a horizontal or vertical drill press, the vise turning 90 deg. for vertical drilling. Both head and base of the drill adjust on the rod supporting the two, and the vise will grip the rod above or below the slide.

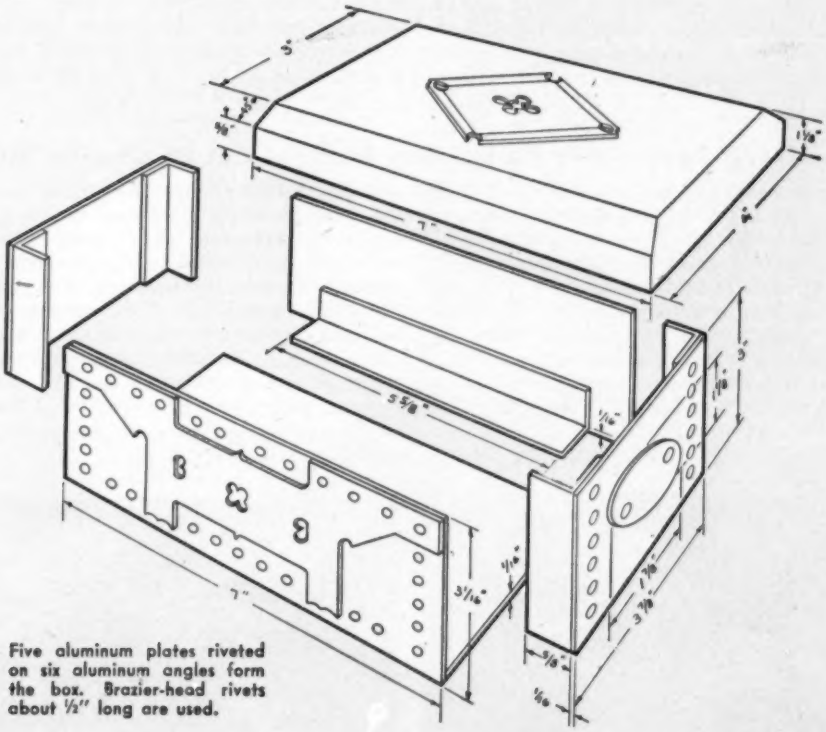


Metal-Ornamented JEWEL BOX

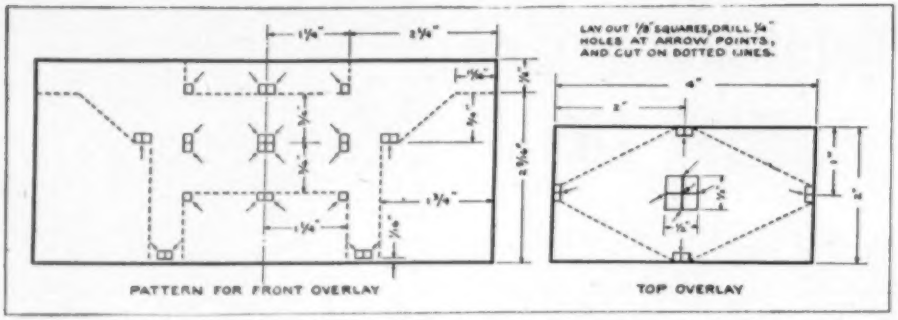
A MODERN material and an antique design are combined in this rivet-studded box to make a distinctly original craft project. The box itself is of .064″ aluminum sheet and extruded angle, while the top is a hollowed block of maple.

Cut the front, back, ends, and bottom to size, and cut pieces for the front and top overlays and the oval end plates. You will also need four ⅜″ by 3″ angles and two ⅜″ by 5⅜″ angles. Lay out the front, ends, back, and bottom for rivet holes. Six at each side edge of the back, 11 at its lower edge, and holes for hinge rivets are sufficient for that piece, while the bottom need only have enough to care for the front and back angles. Drill these holes and use them as templates for drilling the angles and overlays.

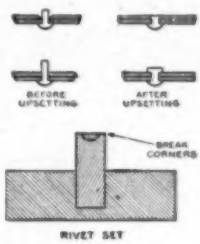
Two methods of riveting are suggested in the drawings. A rivet set can be formed from a short length of bar stock having one



Five aluminum plates riveted on six aluminum angles form the box. Brazier-head rivets about ½″ long are used.



Overlay plates for the front and top are drilled and cut out from the patterns. A rivet set and two methods of riveting are shown at right.



end hollowed with a hand grinder and set in a base plate or held in the vise. Holes countersunk from the inside provide a neater interior. Hold the work squarely on the rivet set, for tilting will mar the outside with a ring around the rivet head.

Rivet the corner angles to the ends first, rivet the overlay and bottom angle to the front next, and then rivet the bottom angle and hinges to the back. A single piano hinge may be used, or you may prefer a pair of old English hinges. Hold the work with machine screws while putting in the first rivets and keep holes clean and free of burrs. Rivet the ends to the front and then to the back, and add the bottom last. Drill the maple slightly undersize, flatten the rivet ends, and drive home with a mallet.

Rub the glaze off the aluminum with fine steel wool and heavy oil, working in one direction only. Sand the maple smooth, and then wax. Cement felt on the bottom and add a cloth lining inside.—R. J. De Cristoforo.

Chair-Leg Tenons Are Kerfed and Wedges Cut on Circular Saw

Round tenons, such as the ends of chair legs that are to be anchored with wedges, can be kerfed quickly on the circular saw. A tenon jig consists of a short length of 2" by 3" stock bored through the 3" face and slotted from end to end so the saw blade will pass through the center of the hole. Adjust the saw fence, insert the tenon in the hole, and slide the jig against the fence to pass the tenon end over the blade, as in the photo at left below.

Wedges may be made from scraps of fairly wide hardwood boards. Saw these across the grain in strips as wide as the desired length of the wedges and as thick as their width. Set the miter gauge a few degrees off square and take a first slight cut to establish the angle of the side of the first wedge. Clamp a stop block to the table as a wedge-thickness guide, and saw wedges by flipping the stock over with each cut until the stock becomes too short to handle safely. A hold-down may be useful, as in the photo at right.—John P. Arnold.

Puppet Dances with the Wind

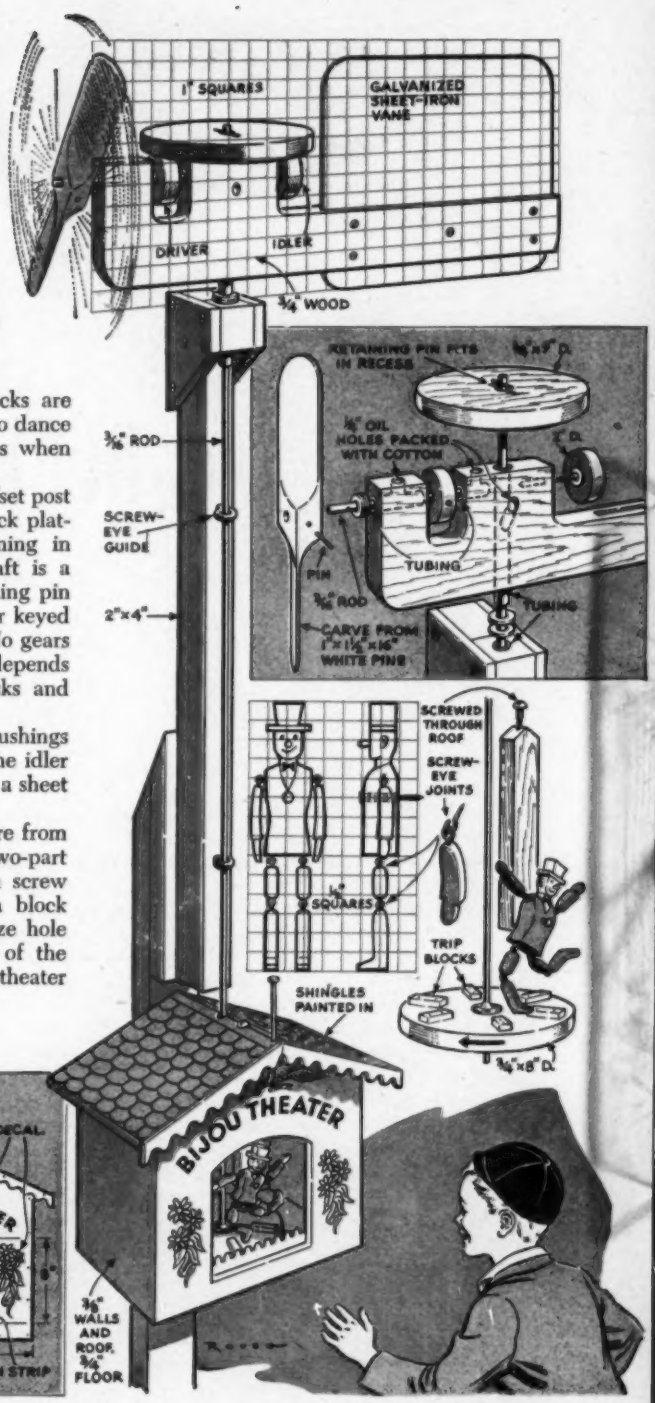
By HI SIBLEY

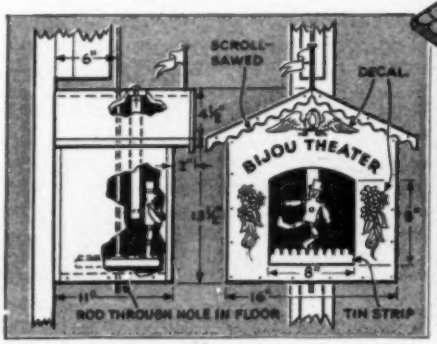
BESIDES indicating which way the wind blows, this weather vane provides a unique dancing show that will delight the young and fascinate their elders. A revolving platform to which trip blocks are glued causes the limber little figure to dance incongruous and unpredictable steps when the wind spins the propeller above.

The propeller is mounted on an offset post and transmits motion to the trip-block platform through a vertical shaft turning in screw eyes. At the top of the shaft is a wooden disk anchored with a retaining pin fitting in a recess. It rides on a roller keyed to the driver and also on an idler. No gears are employed, and the entire action depends on the weight of the revolving disks and shaft on the rollers.

Tubing, preferably brass, forms bushings for the driver and vertical shafts. The idler turns on a screw. A vane is cut from a sheet of galvanized iron.

Whittle the propeller and the figure from white pine and join the arms and two-part legs of the figure to the body with screw eyes. Attach the little dancer to a block with a screw put through an oversize hole and suspend the block to the roof of the theater with a screw. Assemble the theater with brads and waterproof glue.





This model of a firearm for settling gentlemen's disputes may be kept in a glass case or screwed from behind to a plaque.

Old DUELING PISTOL
Whittled from Wood

By CARL G. ERICH

DUELING pistols have long held a fascination. The original of this model had no dates or identification marks of any kind on its plate, but it was probably designed somewhere between 1825 and 1830. It is believed to be of German origin, and was evidently made by a real craftsman. Since it always took two to have a duel, you may wish to carve a pair of models.

Because of the fine carving and engraving, it is best to make the models full size. Two blanks 13/16" by 4½" by 13¾" will be needed for each. Trace the drawing on the blanks, reversing the outline on that for the left side and substituting the left plate for the one to which the hammer assembly is attached. The hammer is made separate and fastened with glue and a slot-head dowel.

Jigsaw the two blanks just outside the outlines. Then glue them together, spreading glue on both halves, anchoring with two brads to prevent slippage, and clamping.

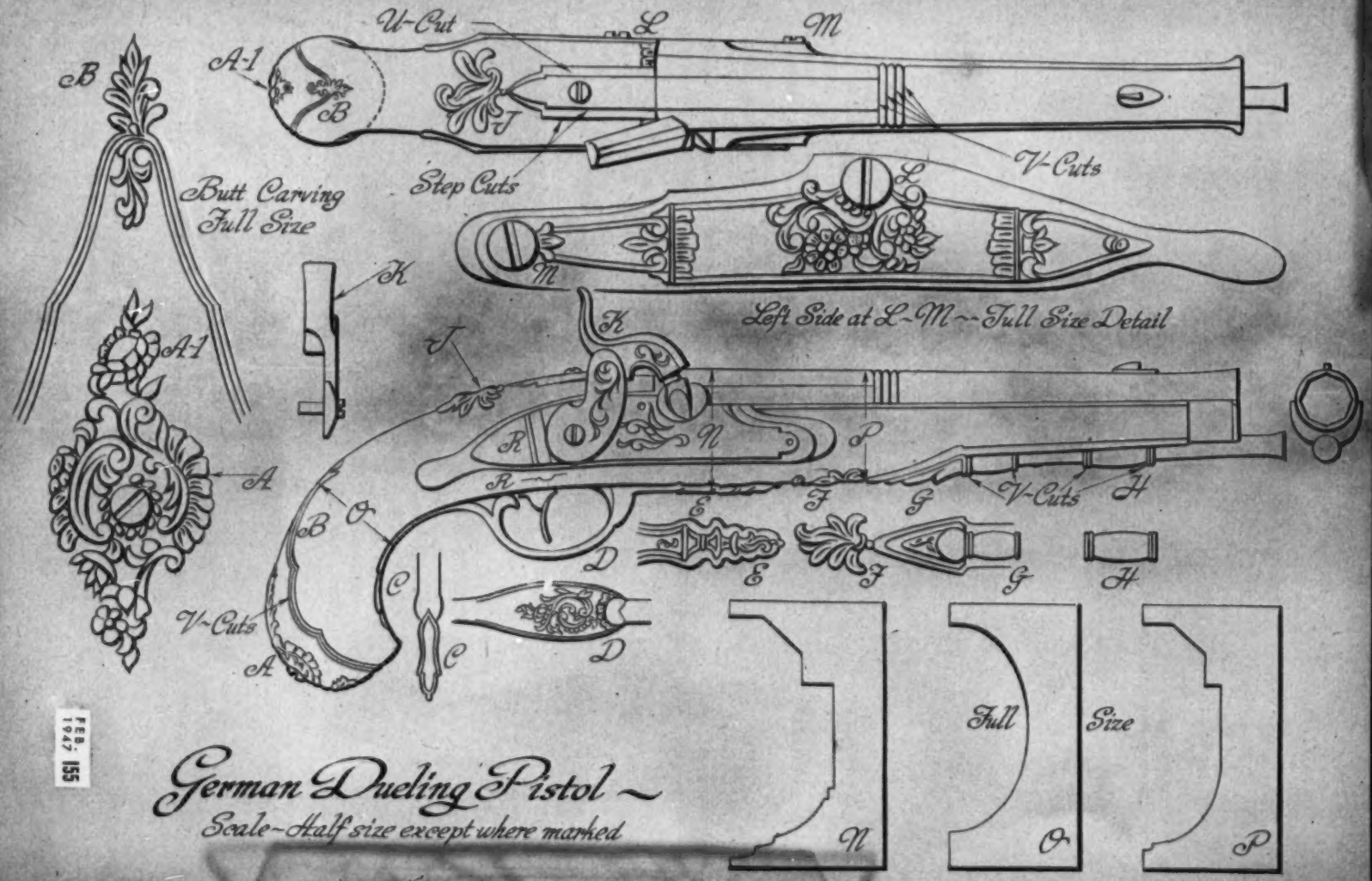
Cut half-section templates *N*, *O*, and *P* from cardboard, and start shaping the barrel first, using the glue line as a centerline. Leave a little stock on for carving, such as at *A*, *C*, *D*, *E*, *F*, *G*, *J*, and the left-hand plate. These are in relief to give a raised appearance. They may be grooved with a veiner or an electric wood-burning needle. Such an iron is a great help when used in connection with a sharp jackknife.

Shape the trigger and guard last, cutting across the grain to avoid splitting. If the parts should split, glue them together and let the glue set before proceeding further.

Note the slight blunderbuss flare of the barrel at *S*, indicating that the original was a short-range pistol. The riflings are octagon shaped, cut with a chisel after drilling undersize about 3" deep. Sand the piece well; then carve and attach the hammer.

For the colors shown on page 120, coat the right-hand plate, hammer, barrel, ramrod, cap holder, and inside of the barrel with liquid stove polish. After drying, rub in liberally powdered graphite, using a pointed stick to get it into corners and taking care not to blacken other parts. Apply liquid bronze darkened with a little stove polish or lampblack to the left plate, *A*, *B*, *C*, *D*, *E*, *G*, *H*, and sight, and coat the remainder with walnut oil stain.

A coat of clear varnish is applied to the stained parts and smoothed with fine steel wool. Then these parts and those treated with stove polish and graphite are again varnished. Rub the stained parts with fine steel wool and oil and the "metal" parts with steel wool alone; then give the blackened parts another light rubbing with graphite for a blued-steel effect.



German Dueling Pistol ~

Scale - Half size except where marked

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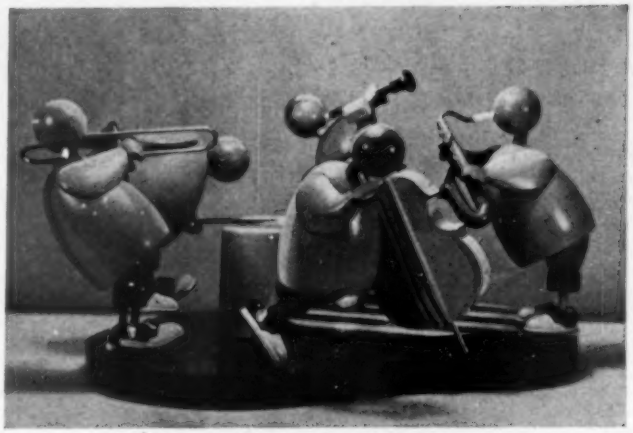
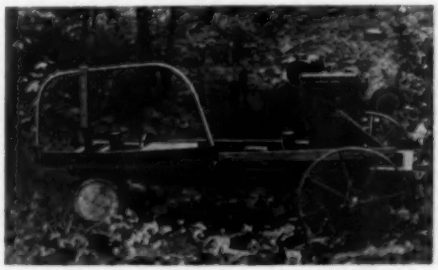
NOTHING WOODEN about the action of these jive cats, though they're all made of wood by Bob Kuntz, of South Bend, Ind. He turns and carves the parts from basswood and mounts them on walnut bases. Shellacked tempera colors give the high gloss. A little brass wire used on the instruments is the only nonwooden material required.



CRAFTSMEN at WORK

TIN-CAN STOCK was the material used in the post lantern shown here, one of a pair made by Charles H. Lohmeier and a neighbor in Lakewood, Ohio. For the inspiration, they went back to an original design by Dr. W. E. Ballard, of Denville, N. J., in the Aug. '42 issue of PSM. Posts on which the new lamps set are 3" downspout embedded in and filled with cement to give them more rigidity.

THIS PORTABLE DRAGSAW was the answer for Howard P. Brown, of Hudson Falls, N. Y., when he bought a wood lot that had been lumbered and was covered with large tree tops. He had acquired a 1½-hp. gas engine about that time, and then along came the Oct. '45 PSM with its plans for a portable dragsaw. Brown followed the plans, adding a ¾" pipe to the blade for extra weight to reduce whip and increase cutting with his somewhat huskier engine. The result was that the unwieldy tree tops were systematically reduced to fireplace lengths, two fireplaces were kept going, and a surplus was stocked for succeeding winters.



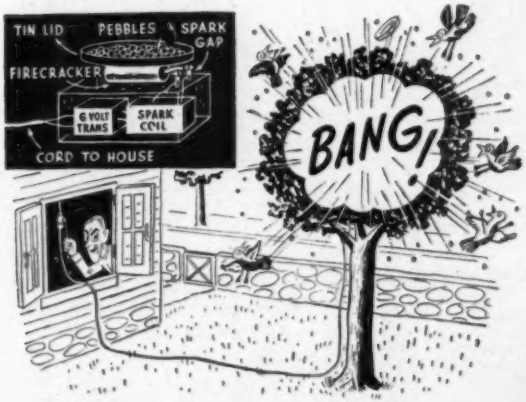
AS A FIRST BOAT PROJECT, one of which he is naturally proud, T. S. MacFadyen, of Ossining, N. Y., built this little cabin cruiser and put it into service as a pleasure craft on the Hudson River. The sleek little cruiser is powered by a 9.8-hp. outboard motor. Original plans for the vessel were published as a four-part series on small-craft building in PSM in Feb., Mar., Apr., and May '39.

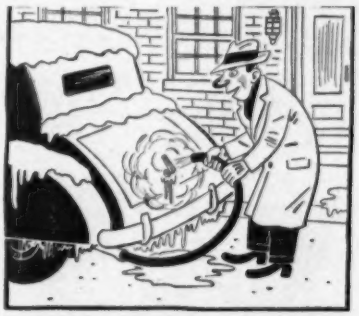
Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.

WHAT'S YOUR INGENUITY QUOTIENT? IQ

IT'S A SAD TALE, but one that's familiar to every farmer who has ever tussled with a cow. After being swatted and switched until it seemed that Bossy's tail was made of lead pipe wrapped in steel wool, one last switch swatted this idea into my head. Now I separate her tail into two strands and knot it around her left leg. —WALLY WALLINGFORD.

I FINALLY BLEW UP when a flock of feathered pirates turned my fruit tree into a free-lunch stand. To discourage their visits, I use a small transformer and a spark coil to spark a firecracker fuse under a tin lid of pebbles, and now when the burglars gather, I just turn on the juice. It doesn't injure the birds, but it does wound their dignity. The news seems to have been tweeted around, for local birds have adopted a "beaks-off" policy toward my fruit.—E. T. RICHARDSON.





I THAWED THIS OUT myself one icy morning when the lock on my car trunk froze up. Heat from the exhaust, piped through a length of garden hose, warmed the lock in a lot less time than it took for the car to warm up.—ORA HENAGER.

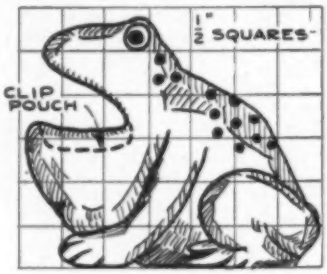
A WEIGHTY SOLUTION was needed when the carriage-return mechanism of my typewriter quit in the middle of some important typing. Until I could have it properly repaired, I did my work with a weighted string pulling the carriage back.—JOHN A. BLAKER.

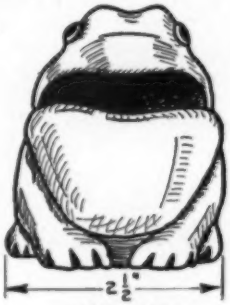
Whittled Frog Paperweight Dispenses Clips and Thumbtacks

ALL blown up and apparently ready to make with a loud "Chug-a-rum," this frog will instead present you with paper clips, thumbtacks, or other desk accessories held in its amply hollowed larynx. Drilled from the bottom with several ¾" holes, which are filled with lead shot and plugged with glued-in dowel disks, the frog will also perform the auxiliary service of paperweight. Save the weighting until after the carving has been completed, but do it before painting.

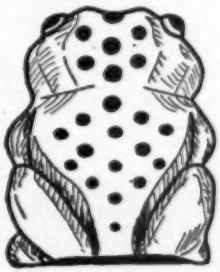
Softwood is best since it is easily worked and finer wood would not show anyway under the paint finish. It should be a block 2½" by 3" by 3½" and may be either solid or glued-up stock. Saw out the profile and carve the contours, turning the work frequently to preserve symmetry. A sharp jackknife is the only tool really needed, but a set of chisels makes the work easier, especially when hollowing the throat cavity.

Sand the piece smooth without destroying the separation cuts and the angles, and then paint. The vest, pouch, inner portions of legs, and inside the mouth may be ivory and the remainder a lettuce green. Apply the darker paint first, and blend the lighter into it at the edges. When the second coat has dried, put in the spots with gold paint and the eyes with black and white, or use thumbtacks for eyes.—ELMA WALTNER.





FRONT VIEW

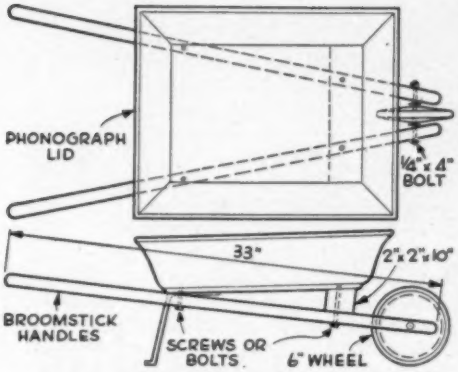


REAR VIEW

Thimble-Size Bracket Holds Flowerpot

TINY dried everlasting flowers or Mexican flowers are best displayed on a whatnot shelf in a container scaled to their size. A sewing thimble—one of red plastic—is ideal if fitted with a scroll bracket bent from light-gauge copper wire, which is easy to work with roundnose pliers.

Bend five lengths of the wire to the shapes shown full-size in the drawing at right, and solder the parts lightly together with a drop of solder at the back of the joints. Before inserting the little thimble flowerpot, the bracket may be given a coat of black or white enamel.—CHARLES H. HARDY.



Lid from Old Victrola Forms Body for Child's Wheelbarrow

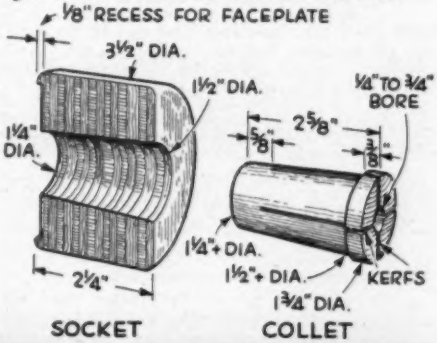
WITH the exception of screws and bolts, all the materials in this child's wheelbarrow are discarded pieces. The wheelbarrow body is the lid from an old Victrola, the shafts are two old broomsticks, the wheel is a clothesline pulley tired with cemented rubber trim salvaged from an old automobile door, and the legs, which may be made from any suitable brackets, are stands from a chicken feeder. Screws or bolts holding the shafts to the body at the front are put through a scrap length of 2" by 2" wood. A ¼" by 4" bolt with washers for spacers serves for an axle.—VERNON F. UNDERWOOD.

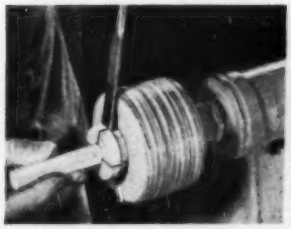
Set of Wooden Collets Holds Dowel Mandrels in Lathe

WHEN dowels are used frequently as mandrels, a tapered socket and set of collets will provide a way for quick centering of standard sizes from ¼" to ¾" in diameter. Glue up three plywood disks for the socket, mount on a screw center, and recess the face to receive a small faceplate, which may be screwed on permanently if another faceplate is available or recentered accurately in the recess if detached. The socket is completed on the faceplate by boring the taper with a narrow skew chisel.

Bore a set of hardwood squares to the desired sizes for the collets; then turn a wooden arbor to fit the largest, force the blank on it, and turn. Reduce the arbor to fit the next size and turn it, and so on to the smallest. Then kerf the collets and finish with shellac.

With a dowel inserted, a collet is tapped into the socket. After the job, the collet is pried out and the dowel stub removed.



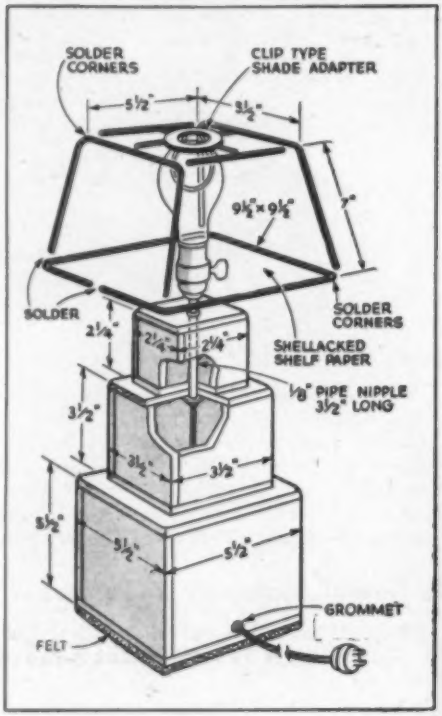


Put a chisel behind the shoulder to pry a collet from its socket.

The taper in the socket hole is bored with a narrow skew chisel.

Collets are shaped from hardwood blanks mounted on an arbor.

Lamp for Child's Room Has Base of Built-Up Toy Blocks

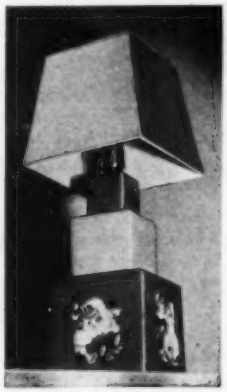


With joints like these, four sides exactly the same are cut for each box. Sand poured in the lowest or sheet lead screwed to the bottom before the felt is glued on prevents top-heaviness.

THREE built-up boxes painted like toy blocks form the base for this lamp designed for a child's room. The shade is shelf paper glued on a soldered frame and shellacked.

Any ¼" to ½" wood on hand will do for the boxes. Line up the three lids and the small and middle-size bottoms for drilling. Assemble with glued-and-nailed butt joints; but before attaching the lid of the middle box, make a trial assembly with a 3½" long pipe nipple through the top box. Adjust the nut to provide threads for the socket.

Round all corners and edges except on the three bases, and sand smooth. Apply two sanded coats of enamel undercoat; then finish with color—a combination such as the apple green, canary, and cherry shown on page 120. Leave the bottoms and a square on the lids unpainted for gluing surfaces between the pieces.



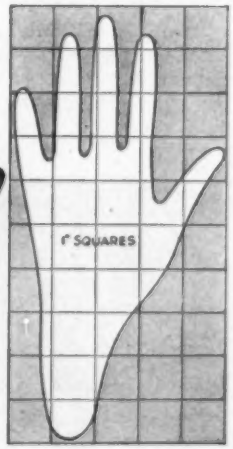
Make the frame of heavy coat-hanger wire. Scrape bright and free of paint for soldering. A clip-type shade adapter is soldered to the top frame with short lengths of supporting wire. —Z. S. GIERLACH.

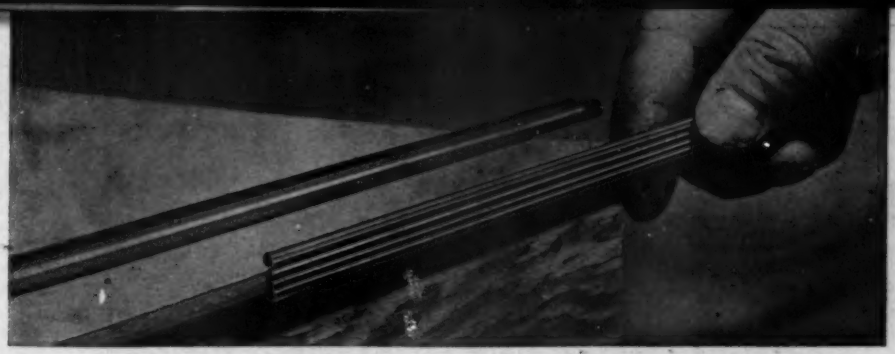
Plastic Hand on Dressing Table Displays Costume Rings

MADE from 3/16" clear sheet plastic, the hand-shaped ring holder shown here and in color on page 120 is a glamorous and practical dressing-table accessory. It could also display rings effectively in a store.

The piece is sawed to shape, and all edges rounded with a file, sanded smooth, rubbed with fine steel wool, and buffed while the masking paper is on. Remove the paper, heat in a moderate oven, and curve, shaping the wrist to a graceful scroll.

Three thicknesses of the same plastic are cemented together for a base, which may be about 3" square. All surfaces are filed, sanded, and rubbed with steel wool. The resulting frosted finish provides a nice contrast, but the base may be buffed clear if desired. Cementing the hand in place completes the project.—DORIS ALLER.





Flat sash rods are slipped on to trim wallboard. The sharp-edged sliding flanges hold them in place.

Moldings

FROM COMMON MATERIALS

FLAT curtain rods, narrow strips of brass or zinc linoleum binding, and even leftover pieces of plain-colored linoleum can be used for finish trim at a fraction of the cost of regular decorative molding.

Curtain rods especially come in a number of suitable designs, and often at a cost of only 10 cents for several feet. Cut off the curved ends first and drill screw holes for applying to the edges of counters, table tops, and the like. Flat sash rods can be slid on the edge of wallboard, composition board, and plywood panels, where they will hold by friction alone.

Seam bindings of brass and zinc are available cheaply in rolls and can be attached with brads or linoleum cement. Strips of linoleum similarly used may require enameling on the edges.—KENNETH MURRAY.

Strip zinc of the type sold for covering seams in linoleum is another good edge molding. It comes in inexpensive rolls and can be bradded on.

A joint between inner sections of curtain rods is hidden by a piece from the wider section. Align butted outer parts on pieces from an inner one.

Sections of flat curtain rods may be drilled and screwed on where an edge molding is needed. Many attractive designs are available.

When a length of flat curtain rod is bent around a sharp corner, a V-section notched in the flange with a triangular file assures smoothness.

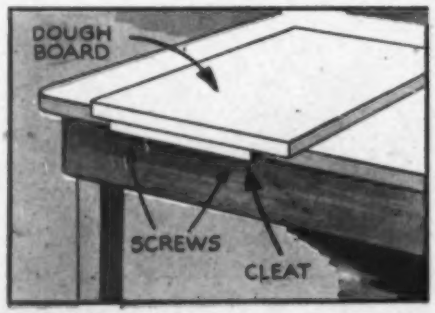
KEEPING the HOME SHIPSHAPE

Stitching a strip of waxed paper into the seam will keep the needle from sticking when plastic materials, such as those in raincoats, are being sewed. The paper is easily torn off and the seam left unmarred when the sewing is completed.

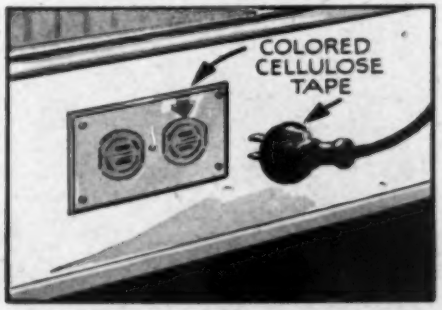
Belts on wash dresses, especially those having an imitation-leather lining, tend to roll along the edges when drying. This can be eliminated if they are stretched around a jar to dry.

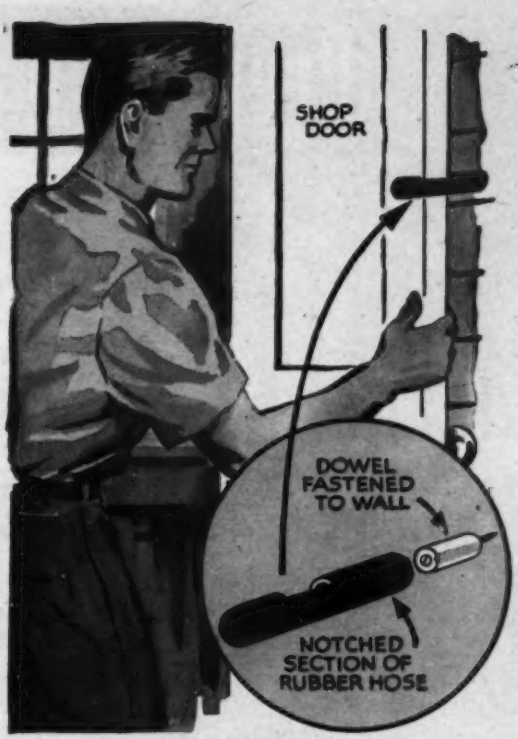
Time spent in making selections from double-face phonograph records can be halved if the titles of pieces are marked on the opposite sides as well. Gummed labels make good identification markers.

With a cleat screwed bench-hook fashion to one of its bottom edges, a doughboard can't skid all over a kitchen worktable when bread is being kneaded or a pie crust rolled out. The board is used with the cleat bearing against the table edge.



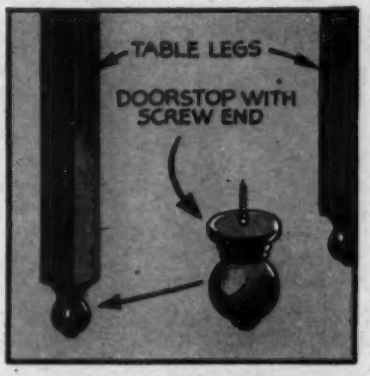
For maximum safety against shocks and shorts, the "hot" (ungrounded) side of a power line and of radio and appliance plugs should be matched. Locate the hot side with a test lamp having one lead grounded, and mark it with colored tape.





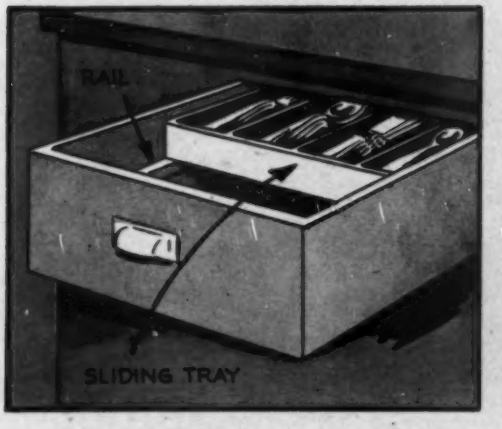
Where appearance isn't important, as in a shop or garage, a length of garden hose notched and cemented on a dowel fastened to the wall holds a door open. Cut one end of the hose on a diagonal. Place the dowel so tension will force the hose against the door and also so the hose will act as a stop to prevent slamming.

Old hands with lanterns sometimes blow one out by giving it a quick jerk. If you don't like this stunt but still wish to avoid burning your fingers on the chimney, drill a small hole in the frame. Blowing briskly into the hole puts out the flame.



Coffee tables and children's tables that have become outmoded can sometimes still be useful if provided with longer legs. The simplest way to raise the height is to fasten an ordinary screw-on doorstop on the bottom of each leg.

Storage space can be saved in a cabinet drawer if the knives, forks, and spoons are kept in a tray built to fit the inside width of the drawer. It should slide on rails nailed to the two sides.



Looped through a washer, the cord of an extension lamp is adjustable for height.

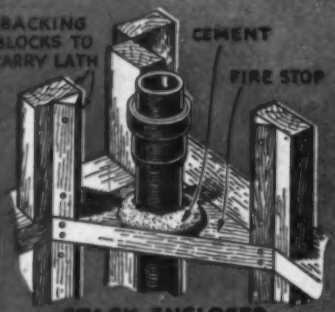
Preparing

By

EDWIN M. LOVE

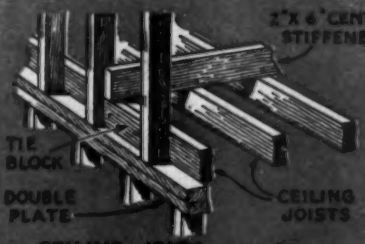
X-braces are needed in rooms with large openings. A hand ax held above clinches nails in the splice.

DOUBLE-STUD WALL ENCLOSES STACK

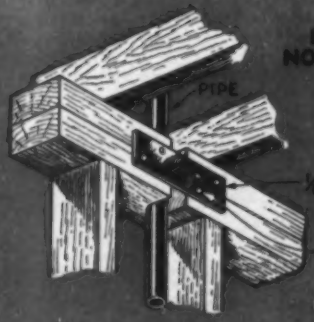


STACK ENCLOSED IN CORNER

1

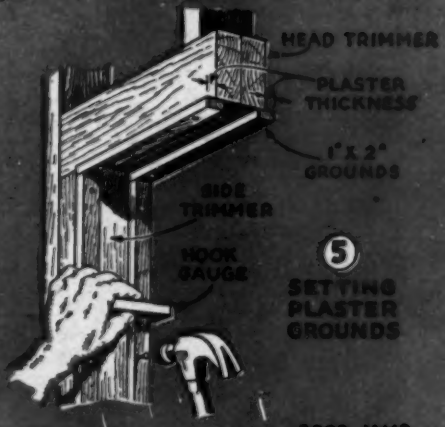


CEILING-JOIST AND WALL STIFFENER 4



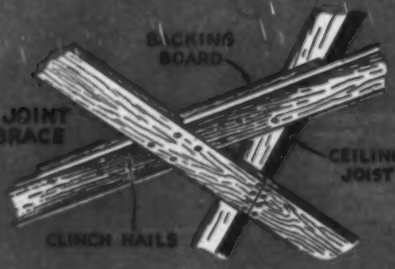
REINFORCING NOTCHED PLATE

2



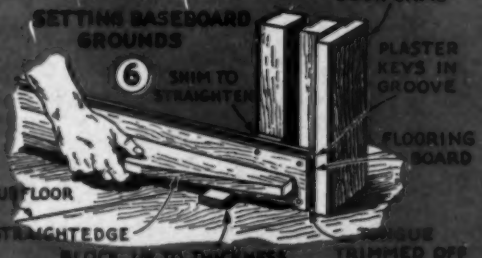
5

SETTING PLASTER GROUNDS



CROSS JOINT OF X-BRACE

3



SETTING BASEBOARD GROUNDS

6

Walls for PLASTER

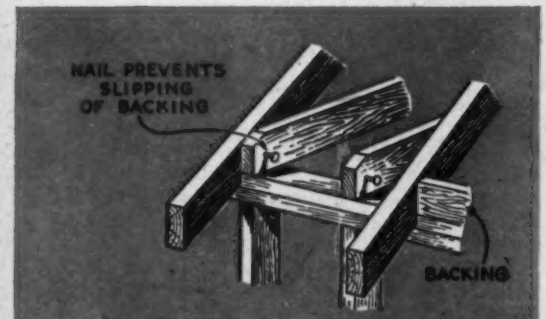
LOCAL laws require examination by a building inspector before the walls of a house are plastered or otherwise finished. There are many small details to be completed before he is called. See that fire stops are installed throughout, even in hollow corners, and calk with cement mortar where pipes come through loose holes.

Stacks for soil pipes are thicker than ordinary partitions and are usually concealed in a wall by doubling the studs in the end of an adjacent closet or by enclosure in the corner of an unimportant room. Both methods are shown in Fig. 1. When the pipe is put in a corner, backing must be provided for carrying the lath both across the corner and on the side walls.

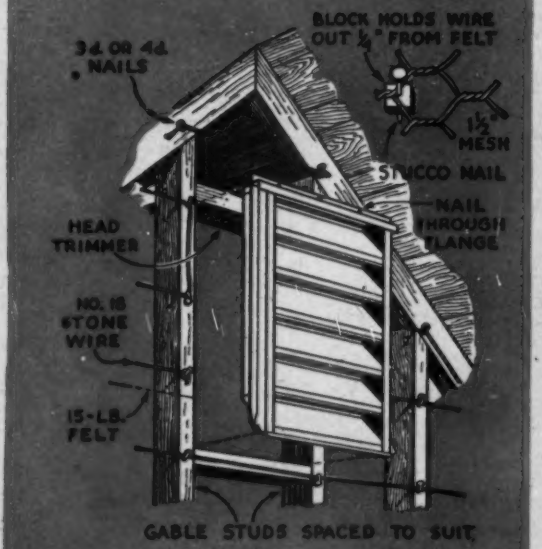
Plates weakened by notching for pipes can be strengthened, as in Fig. 2, with a strip of iron drilled and spiked across the notch. In buildings having large openings, such as garages, ordinary bracing must be supplemented by an X-brace like that in Fig. 3 and in the photo on the facing page. Boards 1" by 6" carried from corner to corner and spliced on joists are adequate.

Gable walls are stiffened several ways. In one of the photos on page 166, 1" stock is nailed to a gable stud and a vertical member in a rafter truss. Where ceiling joists are 16" on centers (Fig. 4), they are stiffened with a 2" by 6" spiked on edge. Nail the end of the plank to an end wall.

Block window sills near the ends with



CLOSING UNDER RAFTERS FOR STUCCO BACKING (7)



PREPARING FOR STUCCO AND INSTALLING METAL LOUVER (8)

Window sills are blocked at the ends, and at the center of wide windows, with 2" wedges driven from inside. The wedges are cut off and covered by the trim apron or by plaster or wallboard.

Gable walls can be given adequate stiffening by a board nailed to a gable stud and to the upright member in a rafter truss. There are other methods; one of them is shown in a drawing on page 164.

wedges driven from the inside; if they are wide, block also at the center. Wedges can be cut with a power saw from 2″ scraps. If the trim apron will cover the ends, the wedges are cut off flush with the sills; otherwise, cut them flush with the trimmers so they will be hidden by plaster or wallboard. Some carpenters drive spikes through the sills and blocks into the trimmers.

Guides or grounds are required to gauge the thickness of plaster at window and door openings and at the baseboard. Window frames themselves serve as window grounds, as do door jambs when they are set before plastering. Jambs can be set after plastering, if preferred, and false jambs made of rough lumber sized to jamb width can be installed for grounds. In Fig. 5, strips 1″ by 2″ are used for false jambs to save material. One edge of a jointed strip is gauged for the projection with a block held against a trimmer and plumbed with a straightedge and level as it is nailed. Then the ground is set on the other side, its distance from the first being gauged with a notched block. Laths are sometimes used for grounds, but they are unreliable.

When baseboards are to be set after plastering, grounds also have to be provided as for doors. It is sometimes convenient to set the baseboards first, letting them serve as the grounds, especially when flooring board is used, as in Fig. 6, and the grooved edge provides a key for the plaster. Trim the tongue and install the board with the grooved edge up. If a finish floor is to be laid, block up the board just high enough to allow the floor boards to go under it snugly.

In most localities a building to be stuccoed is first sheathed, covered with 15-lb. builder's felt, and enclosed with stucco wire for reinforcing the stucco. A popular wire is 1½″ mesh of substantial gauge, but if it cannot be obtained

In mild climates sheathing is often left off when stucco is used, and wire is strung instead for a backing for the builder's felt. It is drawn tight around end nails, being strung with 6″ spacing.

readily, 1" chicken mesh, doubled 2" mesh, or even hardware cloth can be used. In mild climates, sheathing is often left off, and the felt is applied over a backing of wire strung with 6" spacing. This has its advantages since the stucco is not subjected to the strain of shrinking and swelling boards.

Unsheathed buildings must be closed up under the rafters above the walls to provide backing up to the roof. In Fig. 7, a single nail is driven ¾" back in each rafter to hold the packing pieces flush, and these pieces are cut to fit between rafters and toenailed in place.

Mark a stick into 6" divisions and transfer the markings to trimmers at the openings and to the corners of the building, resting the stick on a small nail driven into the sill. String 18-gauge stone wire back and forth over nails driven at these points between the openings and the corners, as in Fig. 8, carrying it clear around the building if convenient, and make the wire taut by driving nails into the studs alternately above and below the wire and bending them over and flattening them down. Wire above reach may be left unstrung until felt and mesh are up that high, and then all the work can proceed after the ladders and scaffolding have been put in place.

Cut convenient lengths of felt, roll loosely, and nail to the studs with large-headed nails. Draw the material up smoothly and trim it along the face of the stucco molding, tucking the edge into the groove. Fit the felt snugly around window sills and bend a flap forward against the underside. Lap the ends of strips about 2".

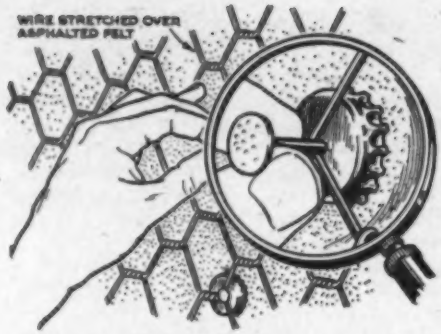
Metal louvers are set as in Fig. 8. Openings to take them are trimmed in the felt. Nail the louvers through the flanges.

If work is being done in a wind, apply the mesh after each strip or two of felt. Incline the stucco nails to draw the mesh tight. Force ends into molding grooves.

Protect window and door sills from spotting by plaster with scraps of lumber tacked over them temporarily. Sash and outside doors may be hung before plastering and, if so, they can be protected from splattering by muslin tacked over the edges of the frames. Even when sash has not been hung, muslin is useful. In cold weather it permits heating of the interior of the building to prevent freezing of the plaster, and in summer it serves to keep out flies. END

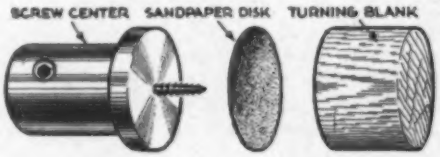
Felt is drawn up smoothly to the stucco molding and trimmed along its face. The end is tucked in the molding groove. Under window sills, the felt is fitted snugly, and a flap is bent forward.

Wire mesh to reinforce the stucco is applied over the felt. It is put on with stucco nails slanted to draw the mesh tight as they are driven home. Force the end into the stucco-molding groove.



Bottle Caps in Stucco Work

If furring nails aren't available, stucco wire stretched over asphalt felt can be held with old bottle caps and 1¾" nails having large heads. Slip a cap under a mesh joint to hold it away from the wall as it is stretched, and nail as shown above.

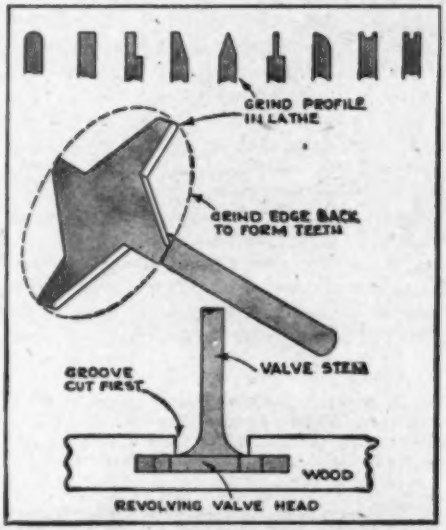


Holding Work on Screw Center

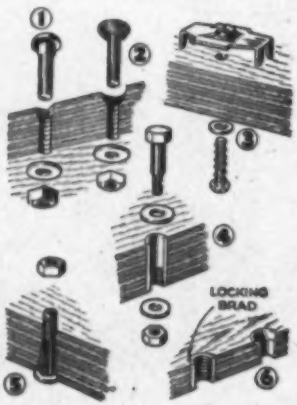
When the screw center is used in the lathe, a wood turning blank can be held more securely if a disk of sandpaper is glued to the center face.—Alfred D. Slater.

Cutting Head Made from Valve

High-speed wood-cutting tools to form T-slots, beading, model molding, model millwork, picture-frame stock, and the like can be ground from worn auto-engine intake valves that may be picked up as junk. Grind the edge of the head to the desired profile after first cutting the stem to a length that won't affect trueness when the tool is revolved. Use a fast carborundum wheel on the lathe tool post and chuck the valve stem to turn as it is ground.—C. L. Meehan.



SPECIAL PLYWOOD FASTENINGS [WOODWORKING]



While the common carriage bolt (Fig. 1) is often useful with plywood, special fastenings are now available. Figure 2 shows a flush-head bolt having a stepped flare that fits into the countersunk hole. Head fins prevent turning. In Fig. 3, a special roundhead screw meshes with a self-locking nut stamped from sheet steel. The clips, bent upward to fit the thread, are drawn down when the screw is tightened, locking it against vibration, while the claws anchor the nut.

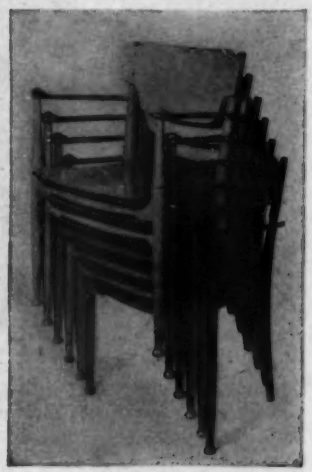
A bolt with a reduced threaded section screwing into a sleeve is shown in Fig. 4. It is locked by a washer and nut. The finned cone of the flush-head bolt in Fig. 5 prevents turning and makes a weathertight and nondistorting fastening.

Figure 6 shows two inserts that prevent damage to holes in plywood parts that are often disassembled. One is a threaded sleeve having two semicircular slots for locking with brads, and the other is a grommet fitting into a countersunk hole and crimped on the underside to form a socket for a flush-head screw.

POPULAR SCIENCE MONTHLY SHOP DATA

Capable of being knocked down and reassembled quickly without the use of tools, the dining-room table and chairs, left, make a sturdy-looking, handsome ensemble. Two leaves and a bar extension are concealed under the top of the table. Beechwood is used for the set and its companion pieces illustrated on this page.

In designing this new line of space-saving furniture, Danish architects O. Molgaard Nielsen and Peter Hvidt took advantage of the possibilities offered by stacking as well as dissassembling. The six chairs shown in the photo below take little more space than a single one.

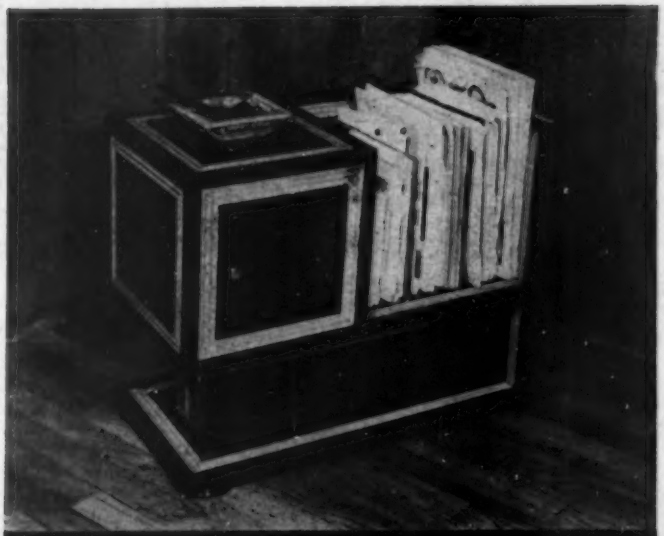


DANISH FURNITURE
Knocks Down for Moving

DESIGNED chiefly for sale in Europe's war-devastated countries, this new line of Danish furniture sacrifices little in visual appeal. Modern in appearance, the simple, functional pieces are well suited to mass production methods. They can be quickly set up or taken apart, thus easing the moving problem on the unsettled continent. Shipping and storing difficulties are correspondingly lessened, since in a knocked-down condition the furniture occupies less than a quarter of its normal volume. Stacking also allows for considerable saving of space.

Units can be used individually or in groups. Counterparts of this single shelf can be added to make an attractive bookcase.

This combination stand holds a full supply of magazines and smoking materials. It is built of walnut with edges of maple and walnut strips in an interesting color contrast that suggests fine inlay work.



Smoking Stand and Magazine Rack

By NORBERT ENGELS

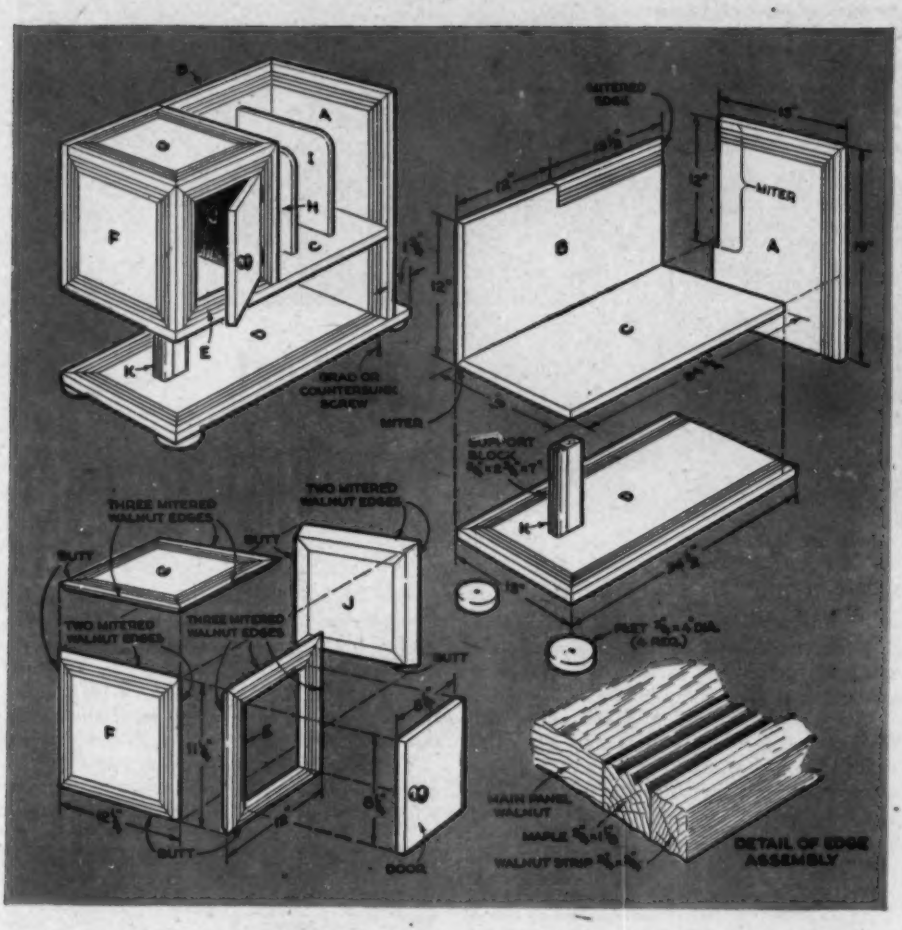
SMOKERS who relish a pipe and a good magazine before a fire on a winter night will get double pleasure from this combination smoking stand and magazine rack. It has room for all the current issues of favorite periodicals plus a few of the old stand-bys, and inside the compartment is space for a humidor and a box or two of cigars or a carton of cigarettes.

The smoker who is also an adept craftsman will get extra satisfaction by making ing the project in two tones of walnut and maple as shown in the photo, though the stand can as well be built by the novice from solid stock or ¾" plywood with one good hardwood face and still be a handsome piece. As illustrated, the light maple strip is fluted on a shaper, but it could be used plain instead and still show a good contrast with the walnut centerpieces and walnut edges.

Glue up the two-toned boards with mitered corners, as indicated in the drawings, using a good waterproof plastic resin glue and a few countersunk brads or finishing nails to prevent slippage when clamping. Put together only a few joints at a time for easier handling, and fill all exposed nail holes with colored plastic composition wood. Square joints and good glue are imperative for a workmanlike job.

Note that *D* is edged only on three sides and *A* on two. In addition, the back edge of *A* is beveled 45 deg. for 12" from the top to form a miter joint with the bevel of *B*. The stripping on *B* is confined to a 1⅞" by 13½" section notched in the right-hand upper edge. *C* is joined to *B* with a miter joint, but is butted against *A*. The support block is a piece faced on one edge with maple and bradded and glued to *C* and *D*.

Maple strips are glued all around the walnut panel for *F* and *J*, the sides of the compartment, but beveled walnut strips are



glued to the maple at only the top and front. These pieces are butt-jointed to the back, and for the outer one, *F*, this butt provides the walnut edging as does *C* at its bottom.

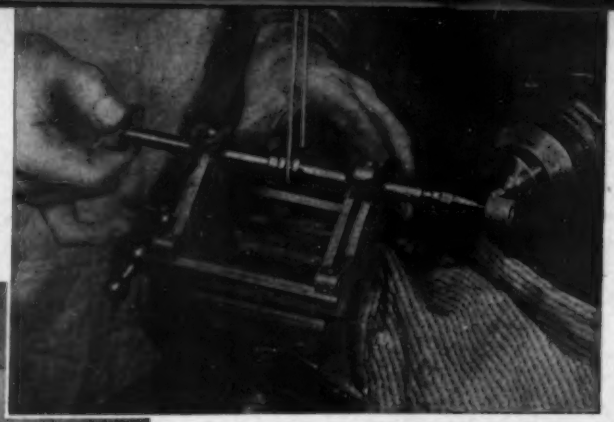
The cabinet top, *G*, is built up with maple strips on four edges and beveled walnut on all but the back. These beveled walnut strips form miter joints with the two sides and the front, *E*, while the walnut butt joint of *B* provides a walnut strip at the back.

Piece *E*, as can be seen, is merely a frame made up of four maple strips edged at the top and sides with 45-deg. beveled walnut. The door, a solid panel of walnut, forms the panel inside the frame when it is closed, and the edge of piece *C*, to which the frame is butt-jointed, provides a walnut strip for the bottom edge. A knob may be turned for the door from a scrap of maple, or a suitable one may be purchased ready made. Small hinges are mortised into the frame and door.

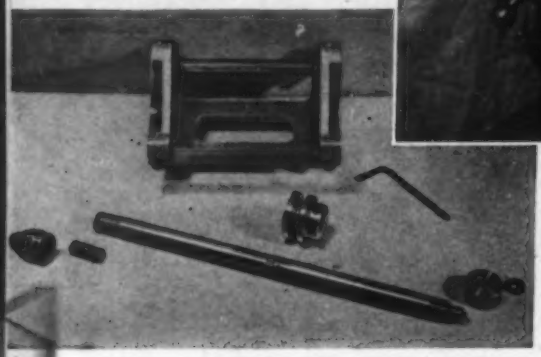
Two partitions are sawed from plywood, one corner is rounded, and they are glued in place and bradded from underneath and from the back. Since they will not show while holding magazines, the quality of the face veneers is unimportant, but they may be stained walnut.

The four feet may be plain wooden disks screwed to the bottom of piece *D* with countersunk flathead wood screws. They may be either walnut or maple to suit taste.

After the stand has been thoroughly cleaned and sanded, a conventional clear-varnish finish will best show the natural maple and walnut contrast. Follow with two coats of paste wax rubbed in with fine steel wool and polished with soft cloth.



Traversed by the control knob, the grinding wheel is fed across the work in the lathe. A long cord belt running to a small motor overhead permits spindle travel up to about 2". A 6" pulley on a 1,750-r.p.m. motor will turn the spindle pulley at speeds up to 14,000 r.p.m.



Low-Cost Tool-Post Grinder

FOR finish-grinding, every lathe owner wants a tool-post grinder. This simplified one, built mostly from scrap materials, has often performed as well or better than conventional grinding outfits.

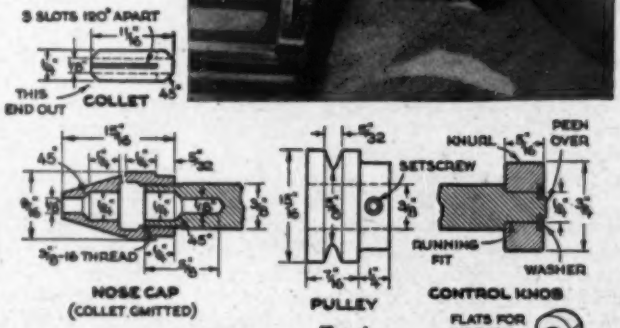
The spindle is a ⅜" steel rod about 7½" long. Use drill rod or other stock ground to uniform diameter and, if necessary, lap it to rotate freely in sleeve bearings with no play. Hold the shaft in a true-running chuck and thread one end ⅜"-24 to receive the conical cap shown in Fig. 1. Drill a ⅛" hole ⅝" deep in the threaded end of the spindle and counterbore this to a depth of ¼" with a ¼" diameter counterbore or reground drill having a 90-deg. included angle between cutting edges.

A flat is filed 3⅜" from the threaded end of the spindle for the pulley setscrew. Turn down the unthreaded end of the shaft to ¼" diameter for a distance of ⅜", and reduce about 1/16" of the end to ⅜" diameter. File two flats ⅜" long on the shaft adjacent to the turned-down part to take a wrench.

Machine and knurl a control knob ⅜" in diameter. Drill a ⅜" hole through and recess it to receive loosely a washer having a ⅛" hole. This washer and the knob are held on the shaft by riveting over the tip of the stub. The knob must turn freely. Machine the pulley from steel and tap for a 3/16" setscrew. Polish the groove.

To make the conical nose cap, first drill a ⅛" hole all the way through, counterbore this with the 90-deg. ¼" bit until only ⅛" of the

The shaft of the grinding wheel is held in a chuck consisting of a conical nose and a spring collet fitting into the recessed spindle.



smaller hole remains at the nose, and finally enlarge the counterbored hole to 5/16" for a depth of ½" so it can be threaded to fit the spindle. Cut flats to fit a wrench.

This nose cap, when screwed down, compresses a tool-steel collet (Fig. 2) around the ⅜" shank of the grinding wheel. Machine both ends of the collet to 45 deg. Inside and outside diameters and the angular surfaces must be concentric. Saw three slots 120 deg. apart in one end for three fifths of its length. Harden and temper the cap and collet.

A lock nut that can be tightened against the nose cap, as in Fig. 3, would prevent unscrewing in use, and a pin to keep the collet from turning could be installed after the spindle is drilled but before it is threaded. Slot the collet to slip over the pin.

The frame and bearings were made from the frame of an old radio condenser and bolted to a steel plate with a stud to fit the hole in the lathe cross slide. Centerlines of the grinder and lathe spindles must be in the same plane. Use felt washers on both sides of the bearings to keep out grit, and loop wool yarn around them and the shaft. Apply oil to the yarn.

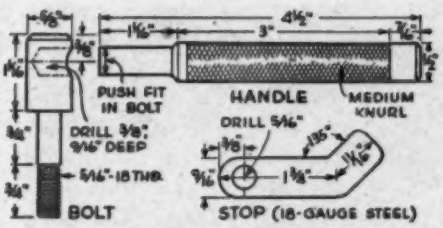
To use the grinder, adjust the spindle to the proper angle with the work and feed the wheel by moving the shaft lengthwise by the knurled knob. Be sure to wear protective goggles and cover the lathe ways.

Quarter Turn of Fixed Wrench Locks Lathe Carriage on Ways

WRENCHES used on a lathe have a habit of turning up almost any place but where you want them at the moment. This one, which in reality is a new lathe-carriage lock bolt equipped with its own permanent handle, can never try your temper by straying just when you are in a hurry.

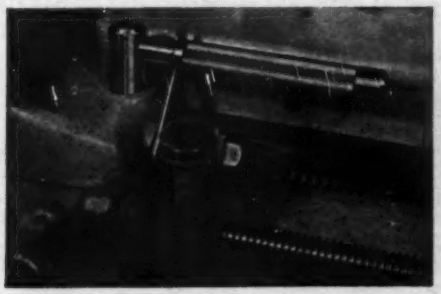
Turn the bolt from cold-rolled steel with a thread to fit the original carriage lock nut, and knurl and turn the handle also from cold-rolled steel. Then, before drilling the bolt head for the handle, engage the bolt in the nut, tighten it on the carriage, and mark the hole position so the handle will be at right angles to the lathe bed when the carriage is locked. Drill the hole slightly undersize and grind the end of the handle to a press fit with the tool-post grinder. When the bolt wears, shims under the bolt head will be necessary to retain the proper handle position.

To keep the handle from swinging against or in front of the tailstock when unlocked, I made a stop of 18-gauge steel. It is clamped between the threading dial indicator and carriage. I also inserted a .075" spacer so the split nut would engage properly in relation to the witness mark on the dial indicator.—JOHN A. BATES.

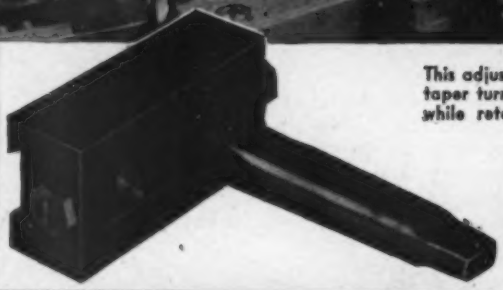


All parts needed for the lathe-carriage lock bolt are shown here, together with finished dimensions.

In the unlocked position, the bolt handle swings against a stop so placed that it will not obstruct your view of the threading dial indicator.



Because of its length, the handle must be pressed into the hole in the bolt head when the bolt is in place, since the carriage limits its swing.



This adjustable dead center can be set over as much as 1" for taper turning, and can be removed to permit straight turning while retaining the critical taper adjustment for later use.

Don't Set Over

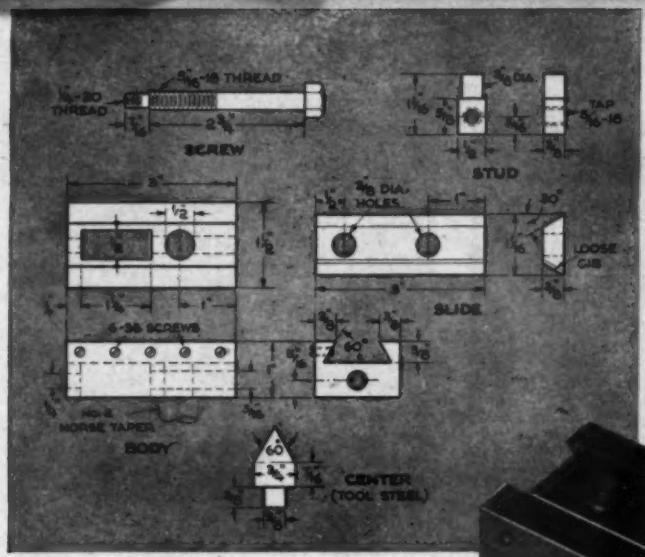
Realigning the dead center after taper turning is a really tough job. Either of these gadgets will save you that trouble.

ONE problem that has engaged machinists since the first taper was turned is resetting the tailstock center for accurate straight turning after it has been set over for a taper. The taper attachment is the ultimate answer, but those who do not have this accessory may find a solution in the two gadgets shown here.

Both employ the same principle of an adjustable sliding center for the tailstock. Either can be set and used for a given taper, removed from the lathe while straight turning is being done, and returned for working on the same taper without resetting. The one shown above and at right is adjustable up to 1" on either side of center and is made in the lathe and milling attachment; the other, on page 176, has a range of only ¼", but it can be made in the lathe alone. Both are formed from cold-rolled steel, except for the center point, which should be tool steel hardened and ground to withstand the wear of off-center turning.

C. W. Woodson built the taper center with a dovetail body and a slide. Five hardened take-up screws and a thin gib lock the device at the desired adjustment and compensate for wear. Mill the dovetail in the body first; then drill lengthwise for the adjusting screw and through the face for a taper shank fitting in the tailstock. The slot in which the stud on the bottom of the slide rides is shaped by drilling overlapping holes and filing. Drill and tap the holes for the take-up screws.

Mill the bevels on the slide, making allow-



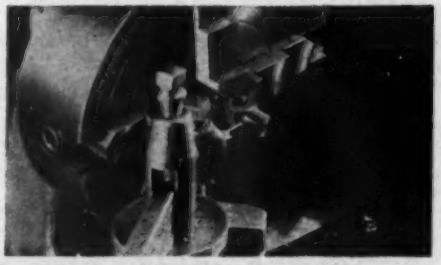
All parts are cold-rolled steel with the exception of the center, which is turned from tool steel, hardened and tempered to resist wear, and accurately ground.

Take-up screws and a thin gib lock the beveled slide in the dovetail body when adjustment has been made by means of a cap screw that turns in a tapped stud. Locking screws and gib are on one side only.

That TAILSTOCK!

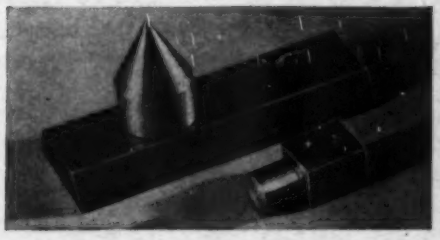
ance for the gib, and drill for the stud and hardened center. Turn the stud from bar stock previously drilled and tapped on the square end for the adjusting screw, which may be made up from an ordinary cap screw. A ¼"-20 nut is put on after the screw is inserted, and the end is headed over so the nut can't come off.

The center point is turned from tool-steel bar stock while held in the three-jaw chuck, the angle being cut by setting the compound rest over 30 deg. Turn the shank at the same chucking to assure concentricity with the point. Harden and temper the point, grind accurately, and drive in tightly after setting the point in a centerdrilled hole or

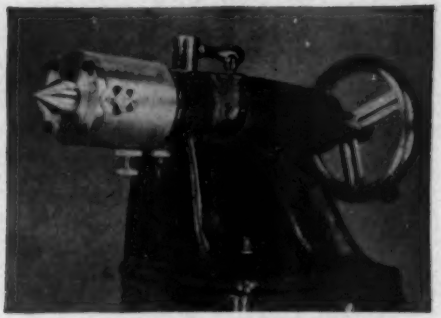


Drilled and tapped bar stock is chucked (above), and a shank is turned to complete the stud. The center is turned, as below, from tool steel held far enough out in the three-jaw chuck for a shank to be turned concentric at the same chucking.

Their shanks driven into holes in the slide, the center point and stud project from opposite faces.



Another tailstock taper gadget can be adjusted by thumbscrews pressing on a sliding center, which is locked in position when the cover is screwed down.



A thumbscrew through the underside engages a key in twin keyways in the body and the tailstock ram, on which the taper center is mounted for use.

on a lead block so as to avoid marring it.

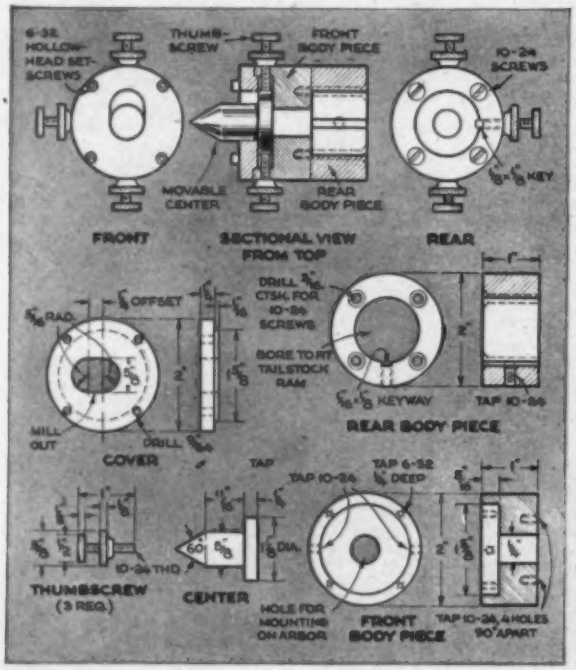
A Morse-taper shank taken from a broken drill makes a good shank for insertion in the tailstock. Turn the outboard end to a shrink fit, heat the body to expand the hole, and drive it on.

Jack Mellinger designed the adjustable-center device shown on this page. It is intended to be clamped on a tailstock ram 1" in diameter and is keyed to the ram for a tight fit and to prevent turning.

Turn the two-piece body and cut the keyway in the rear section by hand filing, taking care to get a tight fit for the key at all points and a close match with the keyway in the ram. Make three thumbscrews, drill and tap the body to take them, and drill and tap for the four 10-24 machine screws.

The cover is turned next and drilled at the center several thousandths under ⅝". Holes are then drilled and tapped for the 6-32 hollow-head setscrews. Assemble, mount on an arbor, and smooth up with a light cut on the outside; then mount on the tailstock ram, check all fits, tighten the bottom thumbscrew, and score the cover horizontally for the slot. This is either cut with the cover mounted in the milling attachment, or made by filing out overlapping holes by hand. If the slot is hand-filed, great care must be taken to keep the two straight edges truly parallel to each other.

Turn the center from tool steel, making the shank a close fit in the slot, and harden and grind. Adjusting the thumbscrews at the sides moves the center to the desired position, where it is clamped by tightening the setscrews in the cover. The center point may be moved toward either the front or back by reversing the position of the cover.



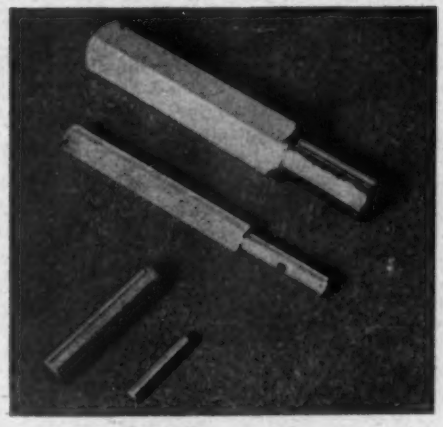
Two pieces are turned to make the body and held together by machine screws. The keyway is cut in the rear section only. These and the other parts are shown in the drawing at left.

NEW SHOP IDEAS

GAUGES FROM DOWEL PINS. Since hardened dowel pins are manufactured to close tolerances, they will serve as gauges if fitted with handles made from hexagon brass or steel bar stock. Sweat-solder the pin into a hole drilled in the end of the handle after nicking the end of the pin in several places on a grinding wheel to insure a good soldering job. The moderate heating required for soldering will not affect the hardness of the pins. Stamp the size of each gauge on the handle.—J. C. MAGEE.

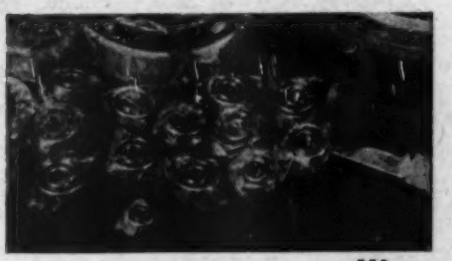
LATHE AS SURFACE GRINDER. The attachment above makes it possible to use any small lathe as a surface grinder. It consists of a pedestal clamped to the lathe bed on which the compound slide, removed from the cross-feed slide, carries a homemade tool post grinder (PSM, Aug. '41, p. 170). This gives vertical adjustment of the grinder.

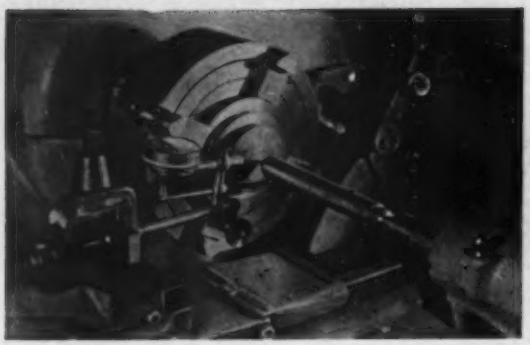
In place of the compound slide, a magnetic chuck is mounted on the cross-feed slide. It was made from the field coil of a radio loudspeaker. The mount of the chuck as well as its work face were both trued with the grinder itself right on the lathe. The 6-volt power supply is an auto generator and a ¼-hp. motor.—R. B. GOODELL.



DRIVING CENTER. A driving center for light work that cannot be gripped by a lathe dog can be made from a broken taper-shank drill. Turn down its outboard end and bring this to a sharp point by grinding three evenly spaced flats. Lightly driven into center-drilled work, the tool gives sufficient driving force for light cuts.

TAPE PROTECTS BEARINGS. When bearings are stored for future use, wash them in kerosene or other grease solvent, oil lightly, and wrap in cellulose adhesive tape to seal against moisture. When a bearing is needed, the transparent tape permits examination wihout unwrapping.—WILL THOMAS.

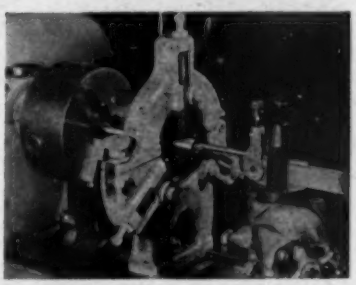




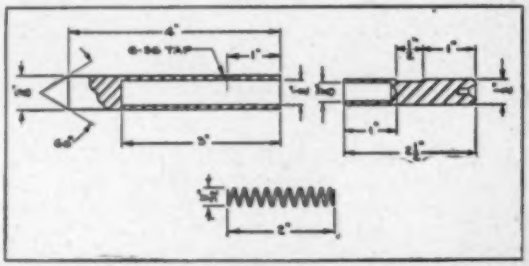
Shown in use with a dial indicator at the left, this center tester must be carefully machined for accurate work. Turn the barrel to a 60-deg. point.

LATHE CENTER TESTER. Used with a dial indicator, this center tester will enable you to center accurately a point or hole in work mounted on the faceplate or in a four-jaw chuck. With the tester point resting in a punch mark or hole and the other end supported by the tailstock center, the dial indicator is brought to bear on the barrel. The work then may be adjusted to run dead true.

Machine the barrel from tool steel, turning it to a 60-deg. point on one end and accurately boring the other for a sliding tailstock bar. Turn the tailstock bar to a snug sliding fit in the barrel, drill a center hole in one end, and bore the other for a coil spring. Assemble the parts, tighten the setscrew to retain the sliding bar, and the tool is ready for use. For greatest accuracy, prevent the tester from turning while work is being indicated.—C. W. Woodson.

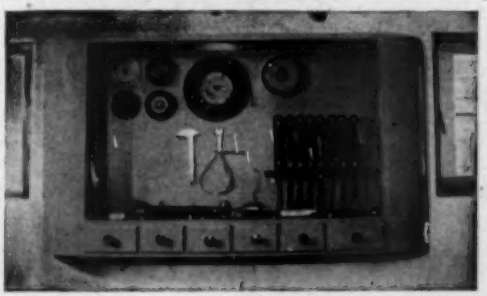


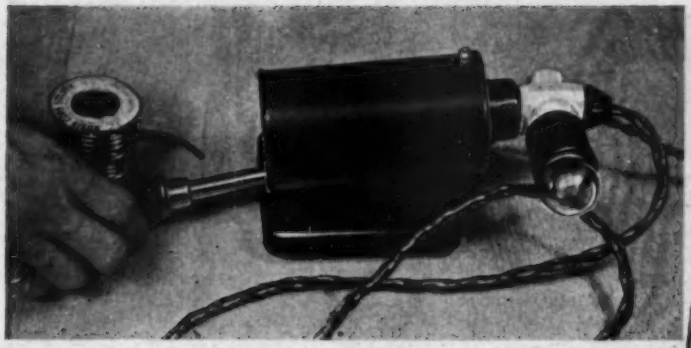
Support the barrel in the steady rest and bore it to a depth of 3" for the sliding tailstock bar. Tap the barrel 6-36 for a setscrew 1" from this end.



Here are the three parts of the tester. The coil spring provides the slight tension needed when the device is in use. The tester itself should not be allowed to rotate with the work.

CABINET FOR LATHE TOOLS. How many times have you been forced to root around and waste good working time trying to find a drill, lathe center, or other small item that you have mislaid? My solution was the lathe accessories cabinet shown in this photo. The six built-in drawers help me keep tab on the small articles. Dowels and a rack provide a special place for each of the larger ones and make them easier to find.—John G. Lownsbery.





The complete stand, at left, turns the current on and off to regulate heat. It is built around the light-blinker thermostat, below.

Soldering-Iron Thermostat

CONTROLS HEAT AUTOMATICALLY

OFTEN the electrical or radio worker will leave his soldering iron connected for long periods simply to have it ready for use when needed. Yet allowing an iron to "soak" in its own heat this way isn't good practice; aside from the current waste, it burns and pits the tip and makes frequent retinning necessary.

This thermostatically controlled stand eliminates these difficulties. As long as the iron is in the stand, temperature is held to a level that will permit almost instant use but still retard pitting; when the iron is removed, it gets continuous current. The heart of the gadget is a little thermostatic element taken from a dime-store light flasher or blinker.

Blinkers come in several styles. Most suitable for this purpose is one constructed on a porcelain base, in which increasing heat opens the circuit. Remove the fine wire that is wound around the bimetal strip, and hold the unit over a flame to see whether heat opens or closes the circuit. If the element is of the latter type, reverse the bimetal piece, bending it so that it contacts the stationary strip when no heat is applied. Next arrange an insulated adjusting screw, as shown in the drawing, to permit you to vary the position of the stationary contact.

The stand employs a soup can as the main housing, a smaller can to position the soldering tip below the thermostat, and a square tin lid as a base. Give the assembly a coat of black stove enamel.

Connections to the thermostat are made with asbestos-insulated wire, and a conventional electric outlet is fastened to the bottom of the housing can. One mounting screw holds the thermostat and outlet on either side of the tin. Punch several vent holes in the can above the blinker element.

Adjust the fixed contact till the unit turns itself on and off just often enough to keep the temperature of the tip above the melting point of solder. A neon lamp used in parallel with the iron will provide a visual check on both the adjustment and operation of the stand.—GILBERT SONBERGH.

Blinkers are made with various types of thermostatic units. For use in this stand, the contacts should open when heat is applied. Wiring and construction details, shown below, may be varied to suit your materials.

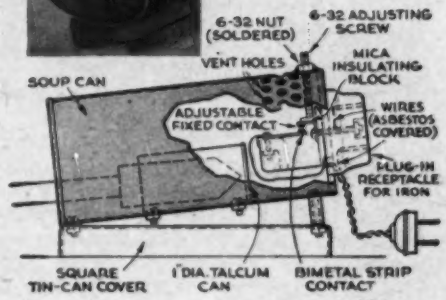


PHOTO IDEAS and EQUIPMENT

CAMERA STAND. A studio stand with one support tube, developed and being marketed by Richard A. Meek, of Richmond, Ind., provides for a wide range of hard-to-get angle shots. A large ball and socket joint gives a wide range of camera angles, and a counterbalancing system makes it possible to handle cumbersome cameras with ease. A minimum of floor interference is obtained by using only two feet on the upright tube. Light in weight, the stand is easily moved.

NEW FLASH GUN. Fitting Kodaks with built-in synchronization, a flash gun just announced by the Eastman Company for amateur picture taking has a 5″ aluminum reflector, a socket for either Class F or Class M midget lamps, and an extension socket.

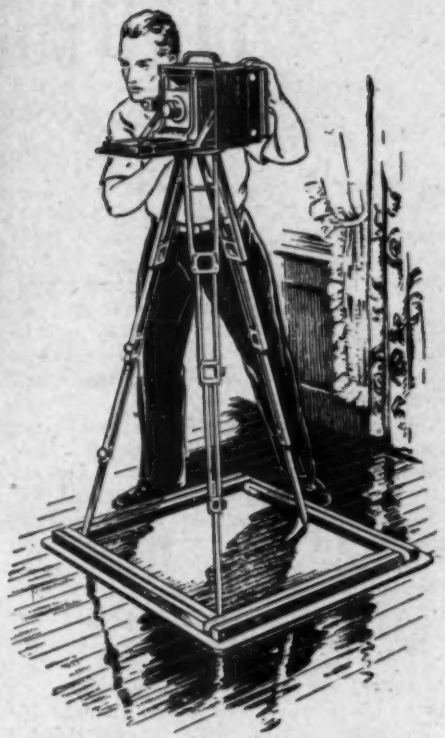
PREFABRICATED DARKROOMS, complete except for purely photographic apparatus, are offered by the Photo Engineering Company, of Hollywood. Delivered knocked down, the parts can be assembled by one man in about 6 hours. In the view above, one wall has been removed.

Occupying a floor space 8′ square and standing 7′ 8″ high, the darkroom is especially intended for garage or basement installation. A unit is fitted with plumbing, shelves, drying racks, a work table, an air filter, an 8′ stainless-steel sink, and a wash tank. The built-in wiring terminates in one piece of BX cable long enough to reach an outlet, and garden hose may be used to supply water and carry away waste, making it unnecessary to call an electrician or plumber unless permanent connections are desired. The darkroom sells for approximately $500.

BABY SPOTS often cannot be used at acute angles because the frame or base restrict movement. This can be largely overcome by attaching a universal-joint tripod head to your lamp stand and mounting the lamp on this, as seen above.—THANE L. BIERWERT.

PHOTO SLIDE RULE. A device produced by the Lawrence Engineering Service, of Peru, Ind., makes it possible to determine quickly the lens aperture and correct distance in feet for various photoflash lamps. It also may be used to find the correct lens opening and shutter speed for color photography.

EMERGENCY TRAYS can be provided by lining shallow cardboard boxes with double thicknesses of waxed paper. Press the paper in but don't make any sharp creases.



POLISHED FLOORS are a dangerous place to use a tripod unless it is equipped with braces and rubber feet. If these are not available, the difficulty may be overcome by folding up a card table, inverting it on the floor, and mounting the tripod on it, as indicated in the sketch above.—G. D. HENDRICKSON.

NEGATIVE DUSTER. An air brush to dust your negatives and lenses is right at hand if you have an old atomizer or other device with a rubber bulb. If desired, the tubing extension of the atomizer can be removed and the bulb used alone.—HERMAN KLEIN.

PLYWOOD CAMERA Does

By Walter E. Burton

ALMOST unlimited are the uses to which this photographic copying outfit can be put. In the office, shop, and home, it can make exact, low-cost reproductions of important documents, letters, checks, data sheets, drawings, instruction sheets, recipes, blank forms, and similar "flat work," and it can be employed for photographing small objects. The work can be done directly on paper or on film.

Any of several sensitized materials can be used. Process film, commercial photographic recording paper, contrasty glossy enlarging paper, and other papers work successfully.

The camera illustrated was designed to take sheets of paper up to 6¾" by 8¾". By varying the dimensions of the holder, such standard sizes as 5" by 7" and 5" by 8" can be accommodated; and by increasing the size of the camera box, larger sizes such as 8" by 10" can be used.

As with any camera, the lens is the most important part. One of approximately 7" focal length is required for a box of the dimensions specified, and it should be, if possible, a good anastigmatic camera lens. If the focus is not around 7", you can use supplementary lenses to increase or decrease it.

A fairly satisfactory substitute for a regular camera lens can be assembled from one or two achromatic lenses, which consist of two lens elements cemented together. One achromat of about 7" focal length, used with an aperture stop, is capable of producing a reasonably sharp image. Two of about 15" focal length, mounted with an aperture disk between them and separated by ¾" or so, have a combined focus of about 7½" and produce images showing less aberration than a single lens.

Since there is a shutter inside the box, the lens can be in a simple barrel mount. The aperture may be in a black cardboard disk. Try various sizes, starting with a ¼" hole. The smaller the hole, the sharper the image will be, but the exposure required is correspondingly longer.

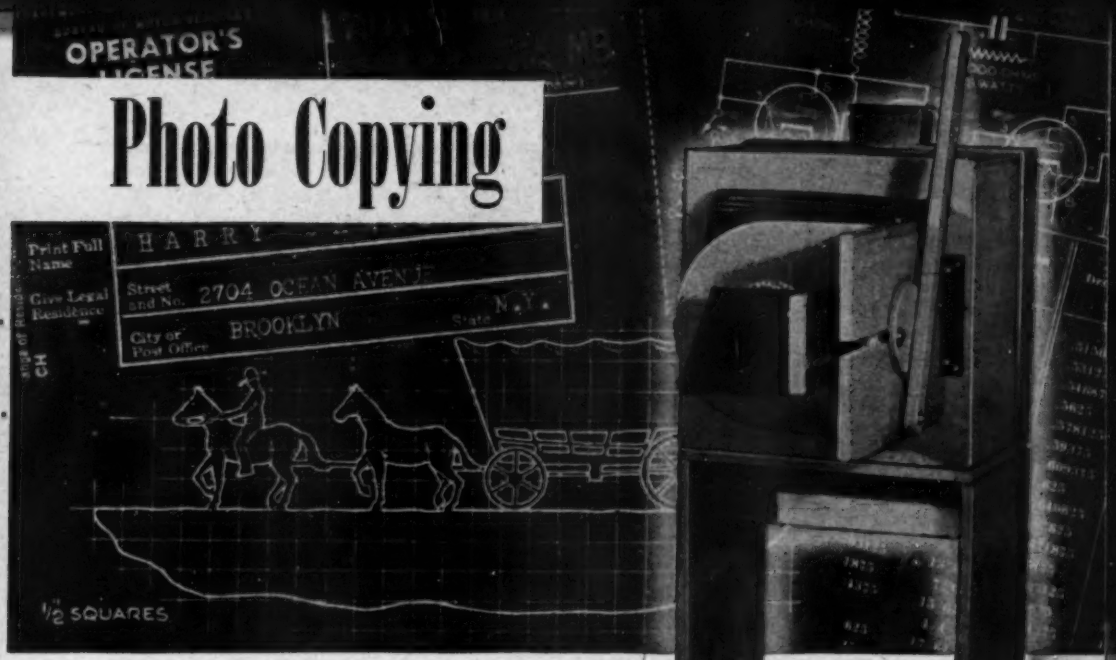
Be sure the lens covers a large enough area, but remember you will work closer to the subject than you would in ordinary photography and the sensitized material will be farther away. Under these conditions, a lens covers a much larger film or paper area than that for which it was designed. In using the camera for making copies the exact size of the original, locate the lens at twice its focal length from both the film or paper and the subject—14" for a 7" lens.

The camera box, built of ¾" plywood, is 6½" deep and 9¾" by 9¾" in the other outside dimensions. Attach a front panel with a centered 5" diameter opening. Along the top and bottom and one side of the open back, brad and glue ¾" by 1¾" composition-board strips, projecting ¾" at the rear to take the paper holder. Make all joints lighttight, gluing strips of wood or cloth along them if necessary, and apply dull-black paint to

Brackets screwed to the lens-board assembly hold the image-reversing mirror at a 45-deg. angle to the lens. A suitable prism could also be used.

Operated by a rod bent at one end for a handle, a shutter of tin-can stock is turned up to shut out light and let down to make an exposure.

Photo Copying



all inside surfaces, the edges of the circular opening, and any other parts that might reflect light to the paper or film.

If any regular plate or sheet-film holders are on hand, the back may be modified to take them, but the paper holder shown is efficient, is easy to make, and holds all edges down so the paper can't curl. Cut the plywood backing first and mark on it guide lines centered with respect to the opening in the back of the camera. These lines should mark off an area the size of the paper or film to be used. Attach .032" aluminum or other thin-metal strips on three sides, and over each attach a second strip ⅛" wider than the first to form channels for the paper. The open end is toward that end of the holder that will project at the side of the camera.

Put a three-sided wood frame around the metal strips, grooving the inside edge ⅛" deep for a dark slide, which may be a sheet of .032" aluminum. Allow ⅛" extra length for a riveted split-dowel handle.

Build up a hinged slide guide of velvet-covered composition board and aluminum or other metal for the open end of the paper holder. Cover the inside surface of the composition-board strip with velvet cut to reach down over the edge and under the base. Glued down, this strip of velvet becomes a hinge so the slide guide can be lifted up for insertion of paper. Spacers and

a top strip, all covered with velvet, complete the guide. Two short pins made from cut-off nails engage the underside to relieve strain on the velvet hinge. Paint the inner surfaces of the holder dull black. The slide need not be painted. Two L-shaped metal clips on the bottom of the camera and a turn button on a block on the top keep the holder in place. Several holders can be made, one for each size paper or film.

Mount ground glass in a frame the size of the paper holder for use as a focusing screen. Have the ground side toward the lens, located in the same plane as the paper or film. Window glass can be ground for use with a paste of water and No. 120 aluminum oxide grains. Rub with a flat piece of metal or the bottom of a small bottle.

The lens is mounted in a board screwed to a sliding panel for focusing. Bent metal strips on the sliding panel ride a rectangular focusing track attached to the front of the camera with angle brackets. The sliding piece is moved by means of a lever screwed to the stationary track and to a wood disk, which in turn is screwed to the sliding piece through a ⅜" slot. Operation of the disk link is smooth, yet enough friction is produced by the large area to help lock the lens in the desired position. Friction can be varied by tightening or loosening the screw engaging the sliding panel.

To reverse the image so it will reproduce naturally, mount an optically flat mirror or large right-angle prism in front of the lens on brackets attached to the lens board or sliding piece. A bellows can be taken from an old camera or enlarger, or one can be made from stiff paper, fabric, or leather, using a camera bellows as a pattern. Frame the open ends with wood and screw them to the lens board and the front of the camera.

Exposure may be controlled with a simple shutter consisting of a rod run through the box to work a leaf of tin-can material that closes or opens the circular hole in the front panel. The rod may go through 1" behind and ¼" below the opening so the shutter will tilt against the front when closed and rest on the bottom when open. Bend one end for a handle. Paint the leaf and rod dull black. Exposures, a matter of seconds, may be timed with a watch. If you do not wish to make a shutter, exposures may be controlled by turning the lights on and off.

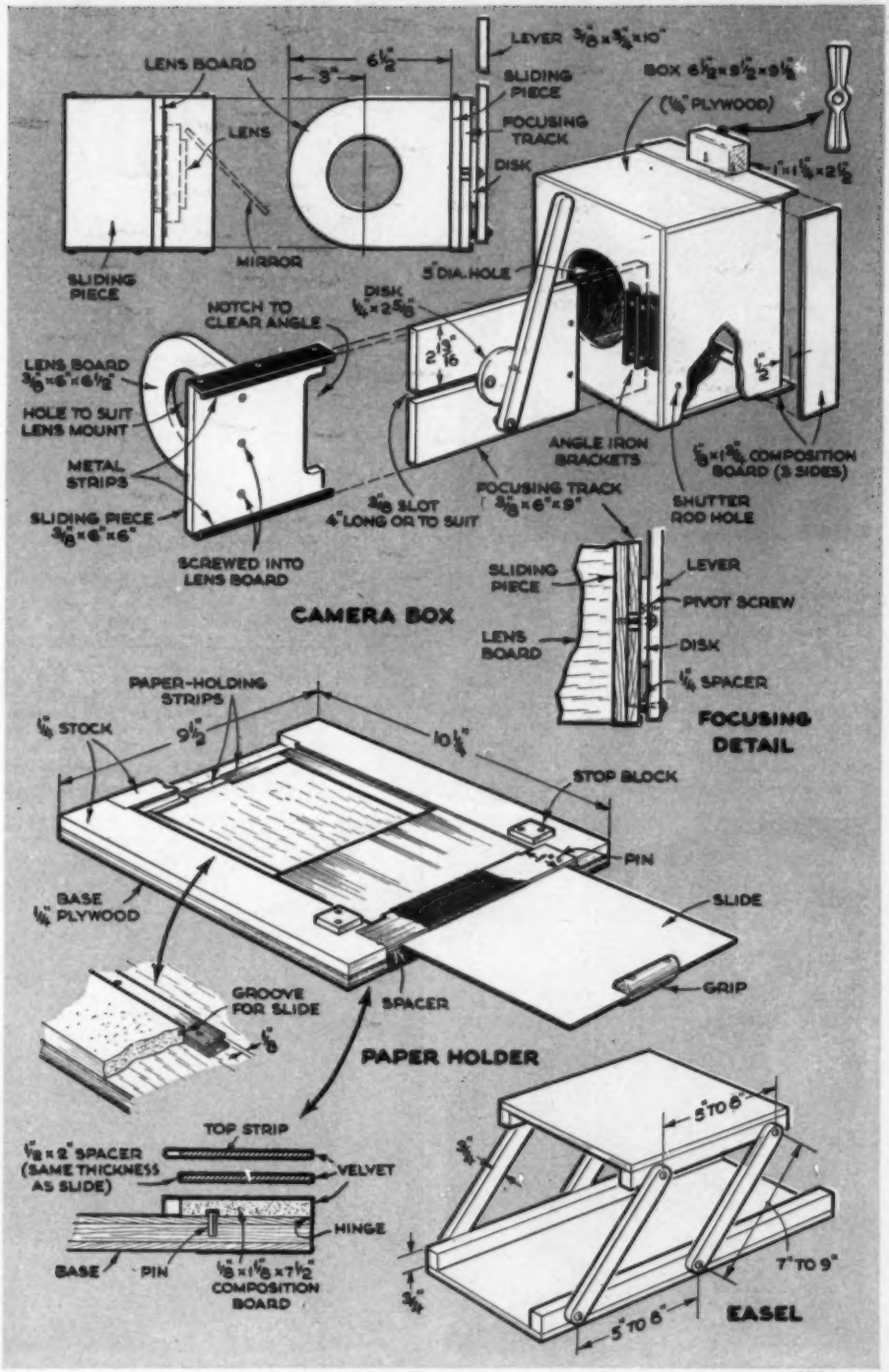
Mount the camera above a working table or base at a height sufficient for the desired range of reproductions. While the lens is twice its focal length from the subject for an exact-size reproduction, the distance must be increased for smaller copies. The camera shown is on a 14" high platform mounted on a 1" by 10" by 28" base.

A horizontal easel for supporting the subject may be made adjustable for height on four parallel pivoted arms and locked by tightening the screws in the ends of the arms. It is separate from the base and is centered simply by moving until the image is centered on the ground glass.

Lighting may be with one or two spotlights placed to illuminate the subject at an angle that won't shine light directly into the lens. Or two photofloods in clamp-on reflectors may be attached to the platform uprights. Lighting should be even and can best be determined by test. Length of exposure is best established initially also by trial. END

Guide lines on the paper holder center the area to be covered by the paper. Strips of thin metal are attached at three sides.

At the open end of the paper holder is a slotted and hinged entrance guide for a dark slide that protects the sensitized paper. Velvet covers the guide.

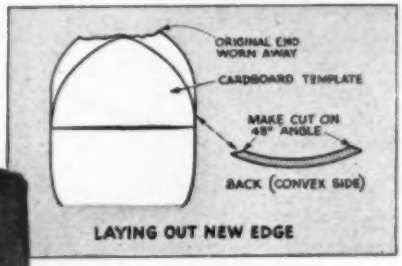

LEVER 3/8"×3/4"×10"
LENS BOARD
6 1/2"
3"
SLIDING PIECE
BOX 6 1/2"×5 1/2"×9 1/2"
(1/4" PLYWOOD)
LENS
FOCUSING TRACK
DISK
1"×1 1/4"×2 1/2"
MIRROR
SLIDING PIECE
5" DIA. HOLE
DISK 1/4"×2 5/8"
NOTCH TO CLEAR ANGLE
2 3/16"
LENS BOARD 3/8"×6"×6 1/2"
HOLE TO SUIT LENS MOUNT
METAL STRIPS
ANGLE IRON BRACKETS
1/8"×1 3/8" COMPOSITION BOARD (3 SIDES)
FOCUSING TRACK 3/8"×6"×9"
SHUTTER ROD HOLE
SLIDING PIECE 3/8"×6"×6"
3/8" SLOT 4" LONG OR TO SUIT
SCREWED INTO LENS BOARD
CAMERA BOX
SLIDING PIECE
LEVER
PIVOT SCREW
LENS BOARD
DISK
1/4" SPACER
FOCUSING DETAIL
PAPER-HOLDING STRIPS
1/4" STOCK
9 1/2"
10 1/4"
STOP BLOCK
PIN
BASE 1/4" PLYWOOD
SLIDE
GROOVE FOR SLIDE
1/8"
SPACER
GRIP
PAPER HOLDER
TOP STRIP
1/8"×2" SPACER (SAME THICKNESS AS SLIDE)
VELVET
HINGE
BASE
PIN
1/8"×1 1/8"×7 1/2" COMPOSITION BOARD
5" TO 6"
3"
7" TO 9"
3"
5" TO 6"
EASEL

Call That SPADE a SPADE?

If you can't, here's how to fix it

By HAROLD P. STRAND

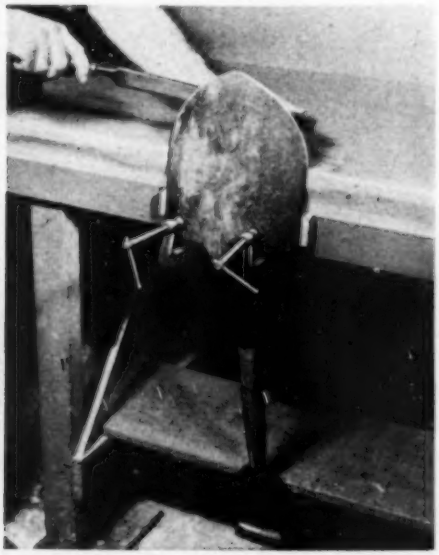
First step in remodeling your worn-out spade is to clamp it securely to the workbench and mark the outlines of a new edge. Use a template as shown in the drawing at right.



LAYING OUT NEW EDGE

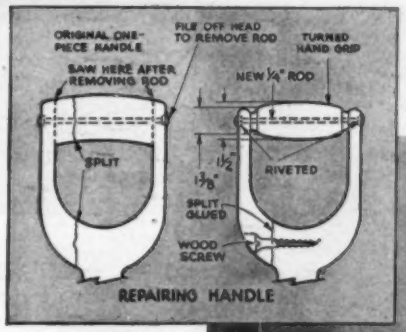
With a 24- or 32-tooth hacksaw, cut away the metal outside the scribed line. Follow the line closely, and hold the saw at a 45-deg. angle to produce a sharp leading edge.

After sawing, smooth and true the edge with a flat bastard file, holding the file at the same angle as the saw. Take care not to blunt the edge. Finish with a finer file if necessary.



If the handle has a split in the wide part as well as in the grip, remove the rod, cut away the broken wood, and allow some glue to run in. Then clamp the parts, drill, and countersink a flathead screw.

Trim the new grip to a snug fit between the yokes and slip a soft-steel rod through the center hole, allowing 1/16" extra at each end. With washers in place, peen over the tips to form tight joints.



REPAIRING HANDLE

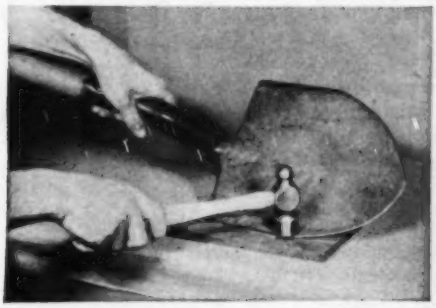
When all the repairs have been made, clean up metal and wood with steel wool and sandpaper; then use paint and varnish.

A new hardwood grip may be turned in a lathe or made from dowel. Drill a 1/4" hole for the new rod.

TEN YEARS is a long time in the life of a spade. So long, in fact, that the tired antique pictured on the facing page had a toe hold on the junk heap before it was brought back to life by a complete overhauling.

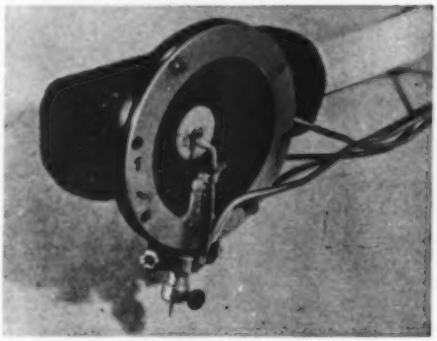
The photos on these pages show the remedies for the two most common ailments of old spades: a blunted blade and a cracked handle. Before attempting the repairs, make sure that the handle is not too badly damaged (in which case a new handle will be needed) and that the metal part has not rusted through. You'll be surprised at how much easier your garden chores become when you use a spade with a clean, sharp point.

If years of use haven't put waves and ripples into the spade, sawing and filing probably have. Place the metal on an anvil or sheet of flat iron and hammer out all irregularities in its edge surface.

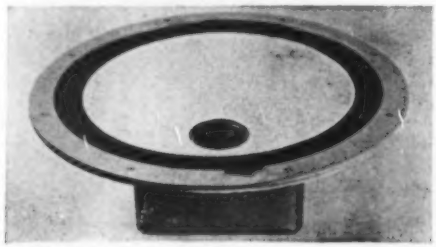


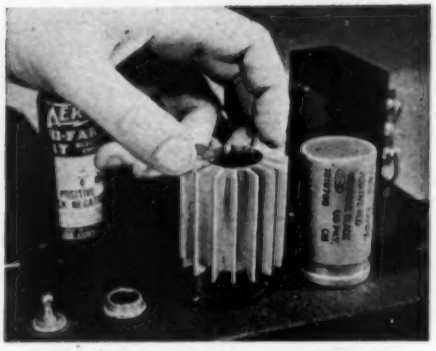
NEWS IN ELECTRONICS

CARBON PICKUPS may provide a means of getting full loudspeaker volume from a phonograph without resorting to amplifiers or tubes. The experimental model shown below is a development of the Electronic Engineering & Manufacturing Co., of Hollywood. Requiring only a D.C. source and operating directly into the voice coil of the speaker, the unit has an output comparable to that of a small radio.

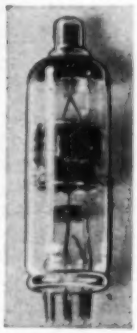


HIGH FIDELITY calls for a loudspeaker that can convert electrical impulses into undistorted sound over a broad frequency band. RCA's dual speaker, below, is designed to give faithful reproduction from 30 to 15,000 cycles per second. Its 15″ low-frequency and 2″ high-frequency cones are combined so that the larger is a continuation of the smaller. This construction minimizes mutual interference in the cross-over region of middle frequencies where both cones are vibrating at the same time.



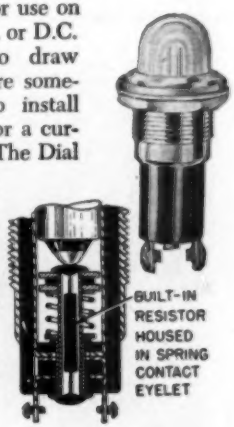


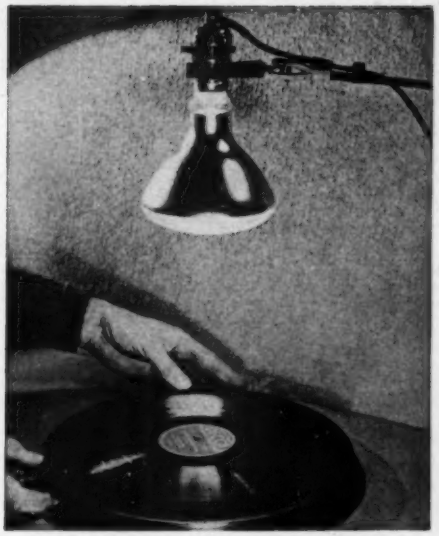
COOLER OPERATION of radios, especially compact, high-powered equipment, helps to extend tube life and prevent damage to other parts. Aluminum fins on the heat-dissipating sleeve, above, carry heat away from the tube where it is generated. The ventilating device is a surplus war item.



TELEVISION rectifiers must deliver high voltages but don't have to take up a lot of space. The 1Z2, left, produced by Chatham Electronics, of Newark, N. J., is less than 3″ long. Two of the midget half-wave rectifiers in a voltage-doubler circuit will supply 20,000 volts at 2 ma. Low dielectric losses make the tube suitable for use in circuits using an R.F. supply.

NEON PILOT lights for use on 115- and 220-volt A.C. or D.C. circuits are made to draw less than 1 ma. but are sometimes inconvenient to install because of the need for a current-limiting resistor. The Dial Light Co. of America, New York, offers a light-and-socket assembly to solve this problem. It houses a resistor whose value may be selected to suit the voltage or regulate the amount of light desired in any particular circuit.



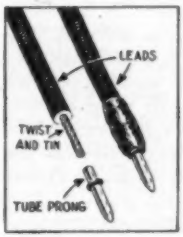


Infra-Red Lamp Rays Flatten Warped Phonograph Records

THE EVEN heat of an infra-red lamp can be used to straighten warped phonograph records. Place the disk on a turntable or a felt-covered level surface and let the beam play over it for about five minutes. When warm the record will usually level out by itself, but it may be helped by gentle pressure. Guard against uneven or excessive heating that may damage records.

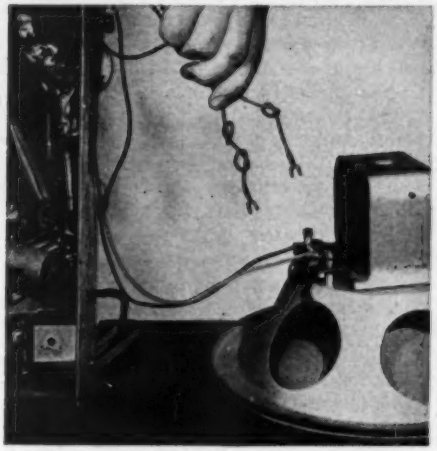
Serviceable Phone Jacks Made from Prongs of Radio Tubes

METAL prongs from discarded tubes can be converted into phone jacks for experimental and repair jobs that arise when you've run out of the regular cord tips. Break away the plastic that adheres to the prong, and unsolder the old wires. Heat and tin the apparatus lead, insert it in the prong, and flow in enough solder to hold the wire. Rubber tape wrapped around the upper part of the pin acts as a grip.—A. M. LINDNER, JR.



Knots Tied in Wires Identify Leads Detached from Speaker

SCREW-LUG connections to loudspeakers usually have to be disconnected when the set is removed from the cabinet for servicing. To make sure that the wires are replaced properly, tie loose knots in the cord ends. The wire with one knot goes to the first terminal, that with two to the second, and so on for all the wires.—H. LEEPER.



Hanger for Radio Test Leads

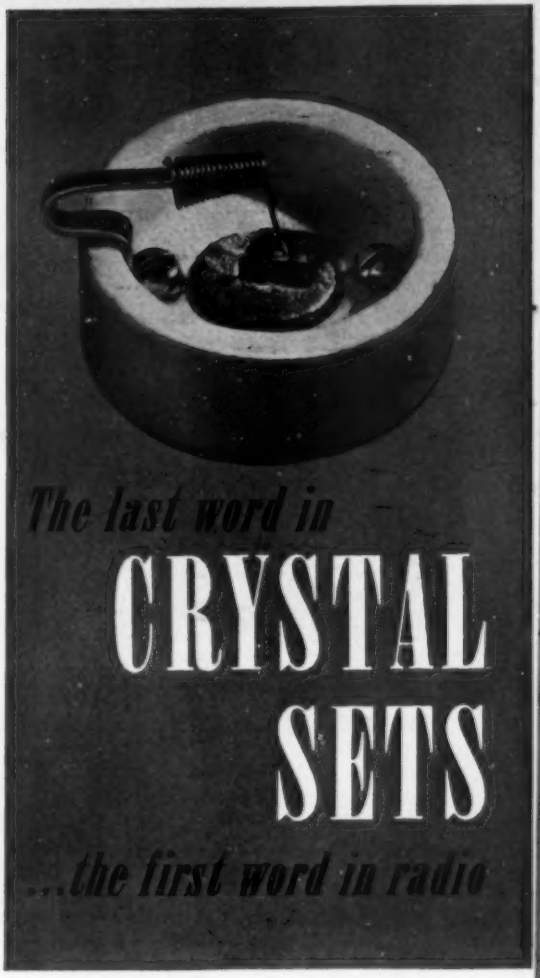
EMPTY film spools, mounted alongside the shop bench as shown at the left, may be used for hanging test leads and other short wires. The rounded body can't cut the insulation or kink the test-lead wires.

Preheat Chassis for Soldering

WHEN the seams of a chassis need to be soldered and your small iron can't work up enough heat, preheating may be the answer. Clean and clamp the joints, apply a good flux, and place the unit in an oven or over a burner. Warm metal steals heat from a soldering iron less rapidly than cold metal.—A. J. SHARENBERGER.

Still the beginner's choice, crystal receivers refuse to die out. These four de luxe versions will surprise you with the things galena can do.

By FRANK TOBIN



CRYSTAL receivers occupy a unique and honorable position in the history of modern science. Almost to a man, the present generation of engineers and technicians grew up on crystals, and it is this generation that has made electronics a synonym for progress and achievement.

With the rapid advance of the radio art, crystal detectors were forced to give way to vacuum tubes. But as much as they've been shoved into the background, these perennial favorites have never passed out of the radio picture. Beginners and experimenters who like to do a lot with a little still find their simple circuits inviting, especially since new developments in crystals have given a boost to the old-fashioned sets.

Take, for example, the novel radio phonograph shown on the next page. The output of the pickup (which employs a piezoelectric rather than a detector crystal) is sufficient to drive one or two pairs of headphones at full strength and with excellent quality. By using a spring-wound motor in place of the one shown, you can make the outfit independent of a power supply as well as of an amplifier.

Most of the space in the standard 4" by 10" by 12" cabinet is occupied by the phonograph. One of the newer fixed crystals (type 1N34) is used in the radio. An antenna coil of the type commonly used in A.C. - D.C. sets and a .00036-mfd. variable condenser are employed for tuning. Connected between the primary and secondary windings of the coil, a midget .00005-mfd. trimmer adjusts the coupling. The looser the coupling (i.e., the more out of mesh the rotor plates are) the greater will be the selectivity and the weaker the volume. Once it is set for any particular locality and antenna, the trimmer need not be altered.

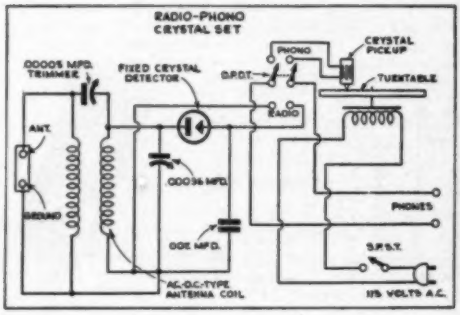
A pickup with as little as .5-volt output will serve, but one rated at 1.5 volts or more is preferable because the output of the phono crystal is fed directly into the headphones without amplification. To vary the volume, use different needles. Soft needles give less headphone volume than hard ones.

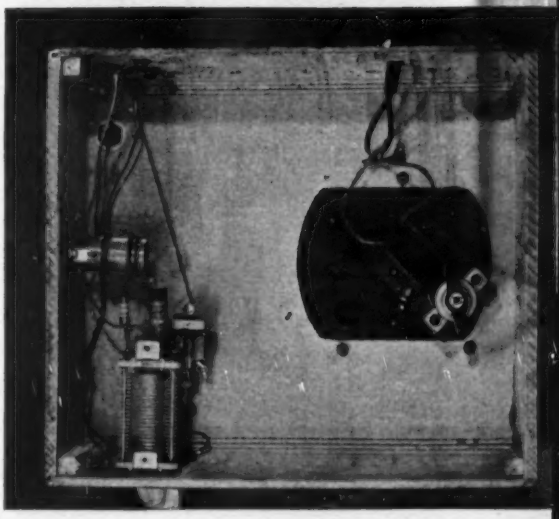
Too much power can sometimes be as bad as too little. Standard crystal receivers used close to several high-powered transmitters often fail to separate the stations, and it is to overcome this weakness that two separate tuned circuits are employed in the superselective receiver illustrated at the top of page 192. Coils L1 and L2, together with a .00036-mfd. variable condenser (C1) form the first tuned circuit; L3 and C2 form the second. Selectivity is obtained in this fashion without sacrificing signal strength.

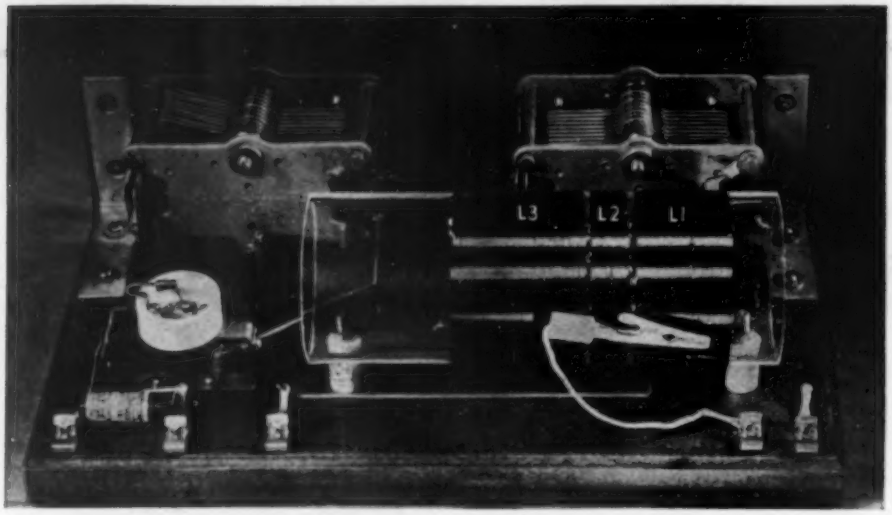
All the coils are wound on a 2½" tube 6½" long. Use No. 24 enameled wire throughout, winding 50 turns for L1, 25 turns for L2, and 60 turns for L3. When a long outdoor antenna is available, better results can be obtained by connecting it to the midpoint of L1.

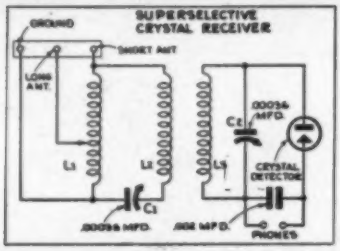
Closest in design to the conventional crystal set that has been popular since the begin-

Radio-phonograph combinations strike a new note in crystal-set construction. The complete yet extremely simple unit shown at the right depends upon two relatively recent developments. First is a high-output pickup that can operate headphones directly without amplification; the second is a preset, fixed-crystal detector. Because this crystal requires no manual adjustment of its cat's whisker, the entire radio can be tucked out of sight inside the cabinet.



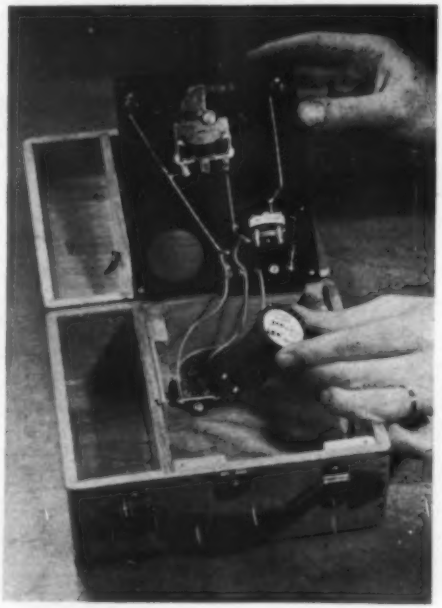




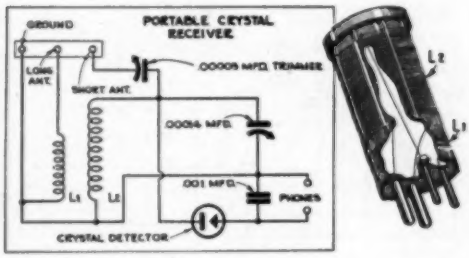


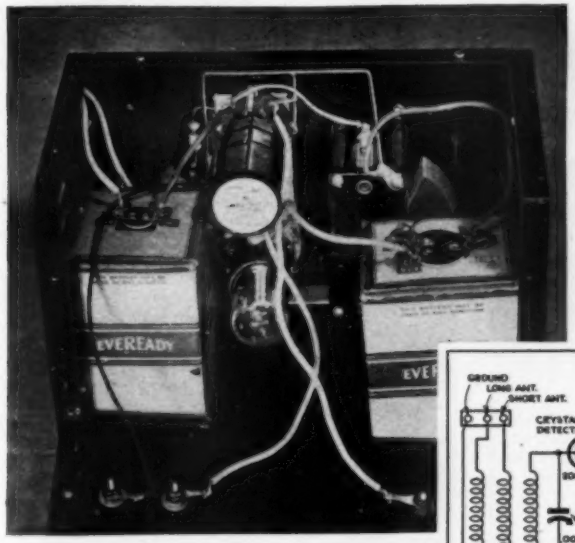
Two separate tuned circuits enable this receiver to distinguish between two or more powerful signals. The alligator clip is used to centertap the antenna coil, L1, when a long aerial is available.

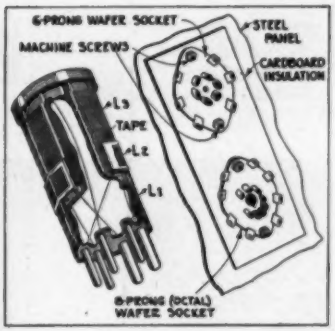
ning of radio is the compact portable shown below. To cover the entire broadcast band with its .00014-mfd. condenser, two sets of coils are needed. These can be made interchangeable by winding them on a pair of 4-prong, 1¾" plastic forms. For use between 200 and 350 meters, L2 should consist of 100 turns of 32-gauge wire, and L1 of 40 turns of No. 36. Leave 1/16" to ⅛" space between the two windings. Stations operating in the 350 to 550-meter range can be tuned in with a coil that consists of 170 turns of No. 34 (L2), and 60 turns of No. 36 (L1). As before, enameled wire is used

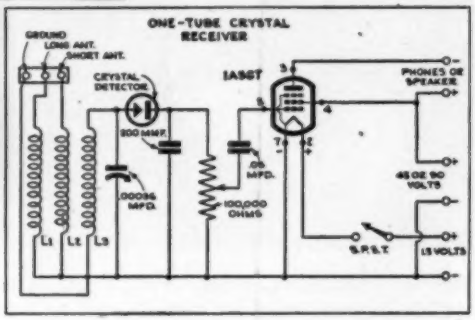


This tiny set makes a fine traveling companion. For use on camping trips, carry a long coil of antenna wire and a spike that can be driven into the ground.









Departing from conventional crystal-set design, this model employs one stage of amplification. With 90 volts on the plate, it will operate a loudspeaker or pull in distant stations.

for all windings. The small left-hand compartment in the 4″ by 7″ by 8″ cabinet will hold a single headphone, the extra coil, a hank of antenna wire, and a ground connection. A stock cabinet is illustrated in the photo, but one like it can easily be glued up out of thin wood stock.

Because crystals can only detect a signal without amplifying it, they rarely give satisfactory performance when used at a distance of 50 miles or more from the transmitter. If you want to double the radius of useful reception, however, you can add an amplifier tube as is done in the circuit pictured above. For phone reception, 45 volts on the plate of the 1A5GT should be sufficient. In addition, local broadcasts may often be picked up with a loudspeaker connected in place of the phones. For speaker operation, plate voltage should be increased to 90. A separate A battery supplies the 1.5 volts needed by the filament.

For the sake of simplicity, all the parts are mounted on the front panel of the metal cabinet. As the chassis panel is grounded, and it is necessary to keep the tube and coil sockets from making contact with it, a cardboard insert is placed between the panel and the sockets as shown in the drawing.

Windings L1, L2, and L3 consist of 40, 70, and 110 turns respectively. For the first pair use No. 36 enameled wire, and for L3 use No. 32. Wrap a strip of tape around the lower end of L3 and wind L2 over the tape. When tuned by a .00036-mfd. variable condenser, this coil will cover the entire broadcast band. The close coupling of L2 is intended to increase signal strength when the set is used with a short antenna.

Several types of crystal detectors may be purchased from radio supply stores, and three different ones have been employed in these four circuits. As far as performance is concerned, any of them may be used in any of the sets, but a fixed, preset crystal is suggested wherever the layout requires that it be placed in some inaccessible spot.

When using an adjustable crystal, move the cat's whisker carefully over the surface while turning the condenser slowly backward and forward until a sensitive spot is found. Don't bear heavily on the contact, and try to avoid touching the crystal with the finger tips as any oily film on its face will reduce the number of sensitive spots.

For maximum performance with any crystal set, use a long outdoor antenna and a good, clean connection to ground.

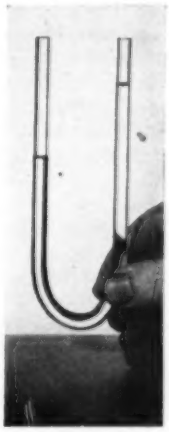
HOME EXPERIMENTS

FLUIDS

SURFACE TENSION causes a liquid to contract until the exterior occupies the smallest possible area, but an external force, such as gravity, may prevent it from doing so. As an illustration, punch four nail holes ¼" apart near the bottom of a wide can, fill with water, and four streams will emerge. Run a finger, held vertically, from one side to the other across the four streams—and they will become one because surface tension overpowers the force that originally kept them apart. Strike a finger, held horizontally, downward across the merged stream near the can and the stream again will separate.

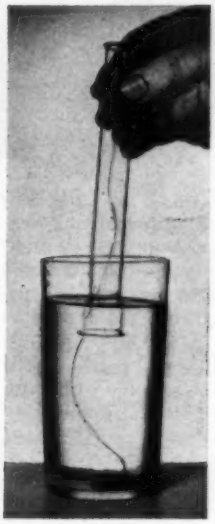
WATER FLOWS UPWARD in a heating system because liquids are lighter in weight when expanded by heat. You can show this by pouring hot water into a vial containing a little ink and standing the vial, mouth open, in a jar of cold water. A plume of hot inky water will rise to the surface and spread like a cloud from a miniature volcano. As the ink cools, gaining density, it slowly descends and mixes with the water.

WATER SEEKS ITS OWN LEVEL, according to an old adage, but here is a trick that seems to offer proof to the contrary. As you can see, the liquid in the bent glass tube in the accompanying photo stands higher in one leg than in the other. That there is no partition in the tube can be proved by causing the liquid to oscillate between the two legs. Actually, the tube contains two liquids. These should look alike but differ in weight. One may be water, and the other a liquid such as benzine or carbon tetrachloride that will not mix with water. The tube should be held so the fingers conceal the juncture of the liquids, although it will be barely noticeable.



Obey Curious Laws

WATER PRESSURE increases with depth, as you can show with a flat piece of lead and a straight glass tube. Attach a piece of thread to the center of the lead and smear petrolatum on the lead and end of the tube to make a watertight seal. Then, holding the lead against the end of the tube with the thread, lower the tube almost to the bottom of a glass of water. If you now release the thread, pressure will hold the lead in place. But slowly raise the tube, and finally the pull of gravity will overcome the decreasing water pressure, allowing the lead to fall.



LIQUIDS MAY LOOK ALIKE but have an entirely different specific gravity. A demonstration of this can be turned into an interesting dinner-table stunt. Pour an equal amount of coffee or tea into two small glasses, and in one dissolve as much salt as you can. Then put a soda straw into each glass and suck gently on both straws at once. Providing you don't cheat, the heavier salt solution will not rise as far as the beverage.

HOT LIQUIDS flow more easily than cold ones, a fact that is obvious in the case of such normally viscous liquids as heavy oil or molasses. Even in a liquid as thin as water, heat has the same effect. As a demonstration, make a hole with a very fine needle in the bottoms of two identical cans. In one, place ice water and in the other the same amount of hot water. Set each over a glass, as at the right, and watch the race. The hot water will flow much faster. In fact, if the hole is small enough and the water level not too high, the cold water may not flow at all.

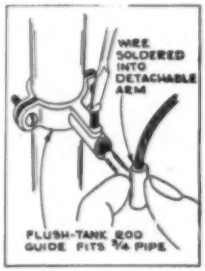
Electric Bell Provides Steady Alarm to Rouse Sound Sleepers

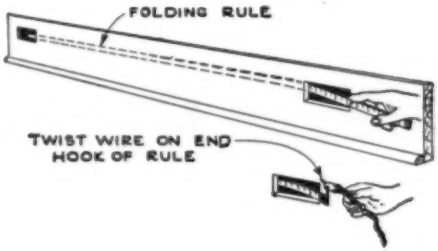
If your wind-up alarm clock runs through its short tinkle without disturbing your slumber, try using this electric bell that will keep on ringing until you disconnect it. It employs a door-bell transformer and bell, housed in any decorative box that blends with the bedroom furniture.

Drill the alarm-wind key for a string tied to a small rod. A spring mounted along one edge of the box acts as the moving contact, while the other connection is carried to a screw head placed beneath the free end of the spring. Bend the last turn of spring wire flat and fill it with solder. When the clock goes off, the unwinding key pulls the rod from under the spring and starts the bell jangling. The contacts can be placed on a ledge inside the box if you'd rather not notch the edge.

Flush-Tank Guide Forms Handy Detachable Ground Connection

When it is desirable to install a pipe ground clamp from which the wire can be readily detached, a rod guide of the type used in toilet flush tanks may be made to serve. To install it, clamp the body of the guide to the pipe, and solder the ground wire into the detachable arm as shown. The arm is then inserted in the guide socket and locked in place with the set-screw. This arrangement will be found particularly convenient in hard-to-reach places when the wire must be removable.





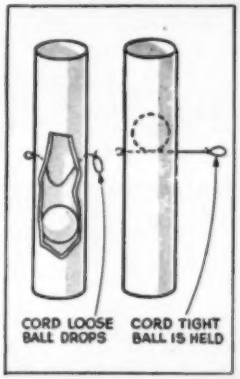
Wire Fished with Folding Rule

Short wire-fishing jobs encountered when installing horizontal wiring in studless partitions and behind built-in cabinets can be done with a folding carpenter's rule, as shown above. Rigid enough to support itself horizontally, yet flexible enough to snake around obstructions, a rule often proves more controllable than conventional fishing wire or ordinary cable.—J. Modroch.

Table Magic

RING OF MYSTERY. Thread a paper ring on a string, give the ends of the string to a friend, and announce you will remove the washer intact while he holds the string. Throwing a handkerchief over your hands, you grasp the ring, and in two shakes your hands emerge—an untorn ring in your hand and the string empty. How? By concealing a duplicate ring in your hand, tearing off and palming the original, and showing the duplicate.

CIGARETTE DEFIES GRAVITY. Borrow a cigarette and place it on a bare table with more than half projecting over the edge. Everyone will expect the cigarette to fall. That it does not will brand you as a magician. The trick is to moisten a fingertip and touch this to the underside of the cigarette at the end which you then press against the table. This moisture acts as an adhesive to keep the cigarette in place.



MAGIC BALL AND TUBE. A mailing tube and a ball that is slightly smaller are needed for this stunt. First, hold the tube vertically and drop the ball through. Next announce that you can so charm the ball that it either will fall through or stay inside. Then produce exactly this effect. A piece of thread through the tube as shown makes it possible to do the trick. One end is knotted; the other is looped over your thumb. When the thread is pulled taut, the ball cannot pass. To let the ball through, slacken the cord.

VANISHING BALL. Place a small ball in your right hand, cover the hand with a handkerchief, and ask everyone in turn to feel under the handkerchief to make certain the ball still is there. When the last person has reported that the ball is there, remove the handkerchief—and the ball is gone. Now replace the handkerchief, and let everyone feel to make sure the ball is not there. Again, when all have had a turn, pull off the handkerchief—and the ball is back. The method used is almost too simple to be believable. Here it is: the last man to feel the ball is a confederate. In the first place, he removes the ball; in the second, he replaces it. Don't repeat the trick too often, though.

Colloids . . . . LIQUIDS

Curious suspensions of certain insoluble substances act like neither—or both.

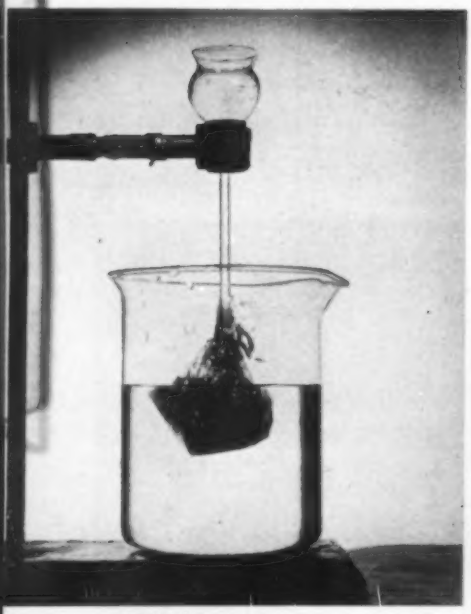
By KENNETH M. SWEZEY

USUALLY we think of physical matter in terms of solid, liquid, or gas, but there is one form that does not fall clearly into any of these three classifications. Science first observed this about the middle of the last century when Selmi, Berzelius, and Faraday produced water-clear liquids containing sizable quantities of insoluble solids such as sulphur, Prussian blue, and even pure gold. In the ordinary sense, these substances were not dissolved in the liquid; yet they remained suspended and could not be seen by even the most powerful microscope.

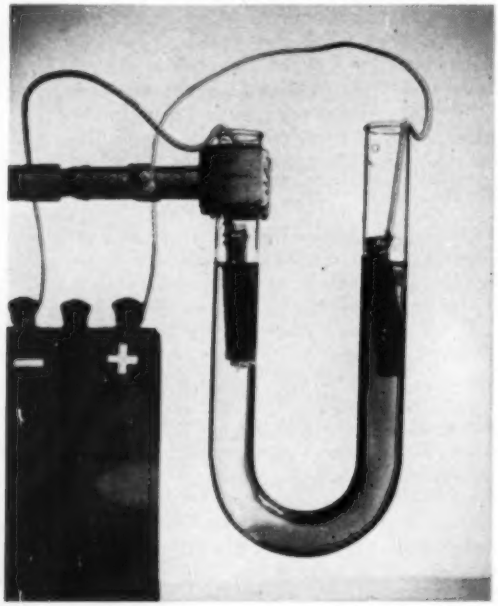
A few years later, an English scientist, Thomas Graham, published his discovery that substances truly dissolved in water would pass freely through parchment paper or animal membrane, while other substances such as gelatin, glue, and the strange liquids just mentioned would not. He reasoned that those that would not were distinct substances, and, as most of those he experimented with were gelatinous, he called them *colloids,* from the Greek word "glue." To distinguish his colloidal suspensions from true solutions, he called them *sols.*

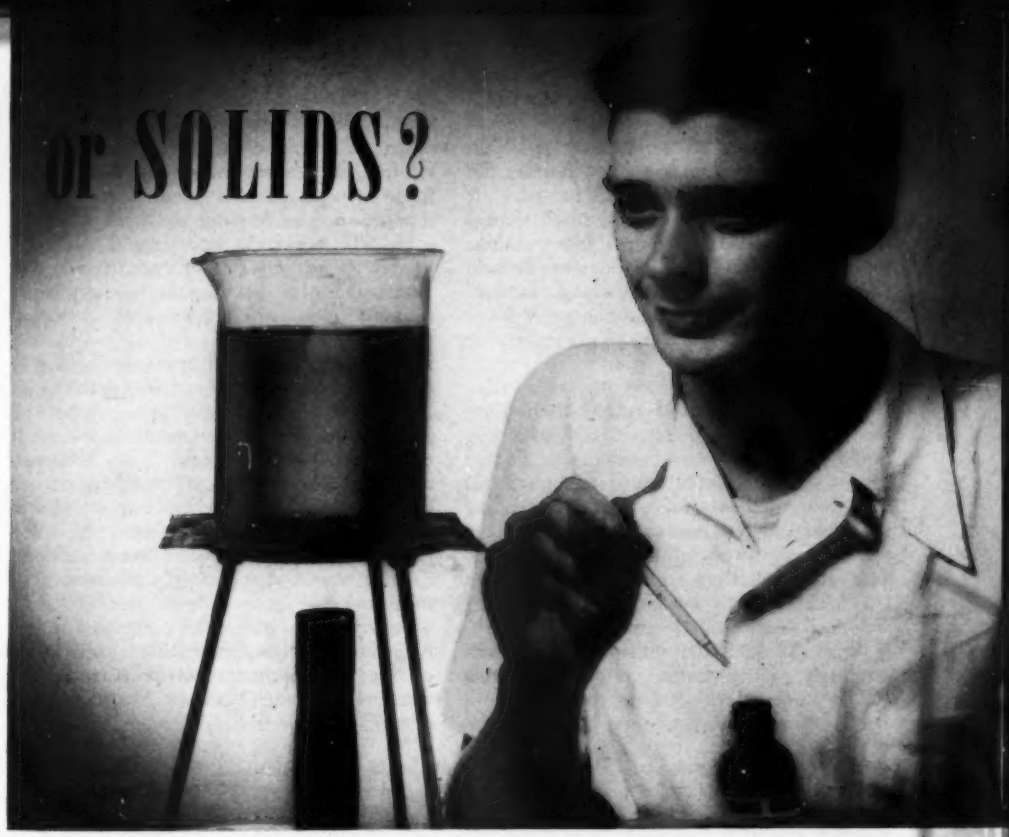
Subsequent investigation has indicated that colloids are not distinct substances, but actually *a state of matter intermediate between solid and liquid.* It is a question of

Sols are purified by dialysis. When the sol is placed in a semipermeable bag suspended in water, dissolved substances pass through the membrane, leaving the colloid behind.



Most colloids possess an electrical charge. You can show this by applying voltage to a sol of Prussian blue. Since this sol is negatively charged, its particles are repelled by the negative electrode and attracted by the positive.





Ferric chloride solution, added slowly to boiling water, yields hydrous ferric oxide in colloidal form.

particle size, rather than kind of material. The smallest particle having colloidal properties is larger than most molecules while the largest still cannot be seen with an ordinary microscope.

Under suitable conditions it is possible to produce almost any substance in colloidal form. This may be done by several methods. The particles may be built up, or condensed, by the reaction of atoms, molecules, or ions; they may be broken down, or dispersed, by disintegration of larger particles.

You can demonstrate this in your home laboratory. Hydrous ferric oxide, which is usually called ferric hydroxide, $Fe(OH)_3$, can be easily condensed into colloidal particles by adding a concentrated solution of ferric chloride to boiling water. The chloride, $FeCl_3$, is rapidly hydrolyzed (that is, decomposed), changing into particles of hydrous ferric oxide so minute that they may remain suspended for years.

This may be observed by adding several drops of ferric chloride to a beaker of boiling water, set swirling by stirring. The pale yellow of a dilute ferric chloride changes, almost instantly, to the deeper reddish-brown of hydrous ferric oxide.

Enough of this sol for experimentation may be made by adding 50 drops of a concentrated solution of ferric chloride, freshly prepared, to 500 ml. of water that is just barely boiling. Add water occasionally and boil until the sol becomes clear and reddish-brown. (By boiling too vigorously, or by adding the chloride solution too fast, you may cause the ferric oxide to be precipitated. If that happens, you must begin again.)

When ferric chloride is hydrolyzed, hydrochloric acid also is formed, remaining in the sol. To remove it, you must use Graham's famous method of separation, *dialysis*. Both acid and colloid will pass through the pores of an ordinary filter, but a membrane with much finer pores will hold back the hydrous ferric oxide particles.

Graham used pig bladders and parchment paper, but today collodion films and non-

waterproofed cellophane serve more effectively. Cut a disk of the latter 8" or 10" in diameter, shape it into a bag, and tie the end around the outlet of a small funnel. Half fill this bag with the sol, and suspend in a large dish of water. After a few minutes, place blue litmus paper in the water around the bag. The water will turn pink, indicating it has become acid. Continue the dialysis for several hours, changing the outside water frequently.

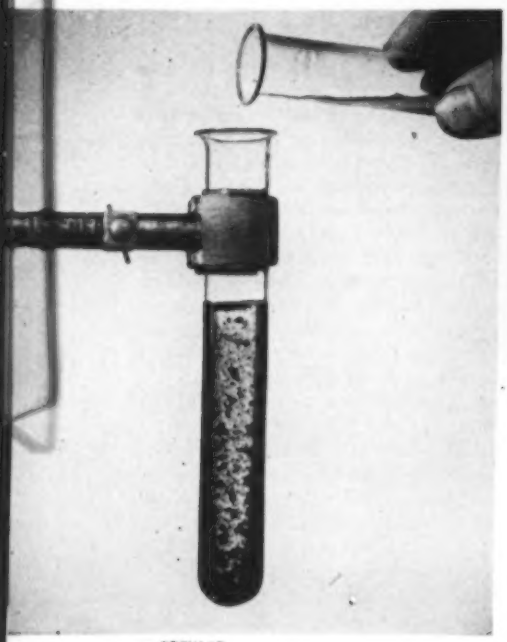
One reason that colloids stay in suspension, against the pull of gravity, is because the molecular movements of the sustaining liquid bounce the small particles back and forth. Another is that most colloids repel each other because each contains an electrical charge. You can demonstrate the latter property by attaching a 45-volt or 90-volt radio B battery to carbons taken from two flashlight cells and inserting the carbons in a glass U-tube filled with a sol.

A sol of colloidal Prussian blue responds strikingly to this test. You can make this sol by adding, with gentle stirring, just 2 drops of a saturated solution of ferric chloride to 100 ml. of water which contains 12 drops of saturated potassium ferrocyanide solution. Immediately the previously water-white solution turns a deep blue. Dialyze this blue sol as you did the hydrous ferric oxide. Then pour it into your U-tube and apply voltage. After a few minutes, you will notice the blue coloring is being pushed from the negative electrode and is concentrating at the positive.

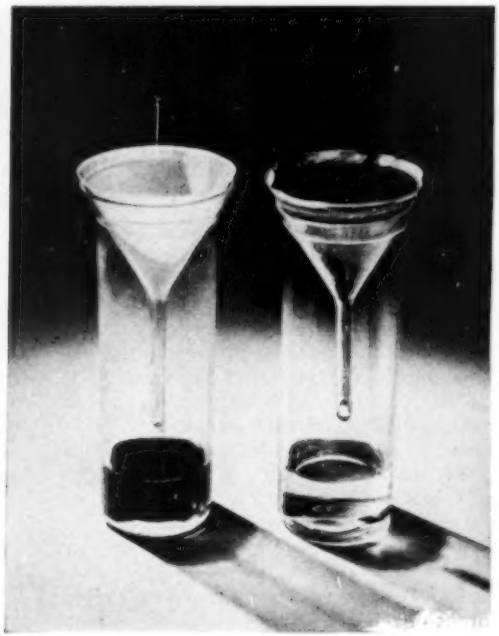
Prussian blue in sol form is negatively charged. Hydrous ferric oxide, on the other hand, is positively charged, as can be proved by repeating the experiment with the other chemical. The movement here, however, may not be so pronounced, for this substance tends to precipitate when it concentrates at the negative pole. Many dyes are colloidal and are selectively attracted to different types of textile fibers largely because of an electrical charge.

As you might guess, the particles in negatively and positively charged sols, when added together in the proper proportions, are attracted to each other. Therefore, the charges are neutralized, and the particles

If negative and positive sols are mixed, the particles will neutralize each other. Usually, they also coalesce and are then precipitated. Here, a hydrous ferric oxide sol is added to another of Prussian blue.



Mix dilute solutions of potassium ferrocyanide and ferric chloride, and you produce a colloidal blue sol that leaves hardly a trace of blue in passing through a filter, left. But mix concentrated forms of these substances, and the particles are so large that the filter holds them back.



often fall out of suspension. You can verify this by adding hydrous ferric oxide sol to some sol of Prussian blue. Large particles will form and fall to the bottom.

Acids, bases, or salts added in sufficient quantity to an electrically charged sol also will discharge it and cause precipitation. In city water systems, this is the principle involved when aluminum or iron sulphate is added to clarify muddy water.

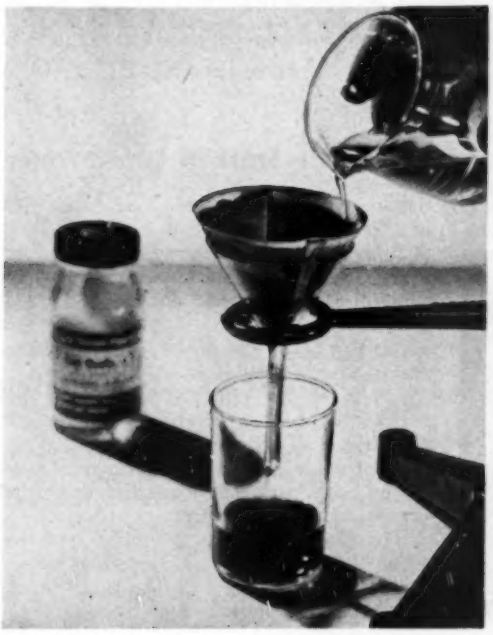
Sometimes substances may be prepared in either colloidal or grosser form, by controlling the concentration of the substances. If you pour Prussian blue sol into an ordinary filter, the blue will pass through, leaving no solid matter and hardly coloring the filter. But make a new batch of this blue, this time adding 10 drops of ferric chloride solution and 20 drops of potassium ferrocyanide to 100 ml. of water, pour it into a filter—and note the difference. Although the first ml. or two of the filtrate may be pale blue, the remainder will be colorless and a precipitate of the blue pigment will remain in the filter. Chemically, the two Prussian blues are almost identical; physically, the first is colloidal while the second is not.

One method of breaking down large particles to make them of colloidal size is called *peptization*. You may demonstrate this process by pouring a dilute solution of oxalic acid through the precipitate of gross Prussian blue on your filter. Immediately the blue begins to pass through the pores of the filter. If the filtrate is subsequently dialyzed to remove the oxalic acid, the blue will remain in colloidal form.

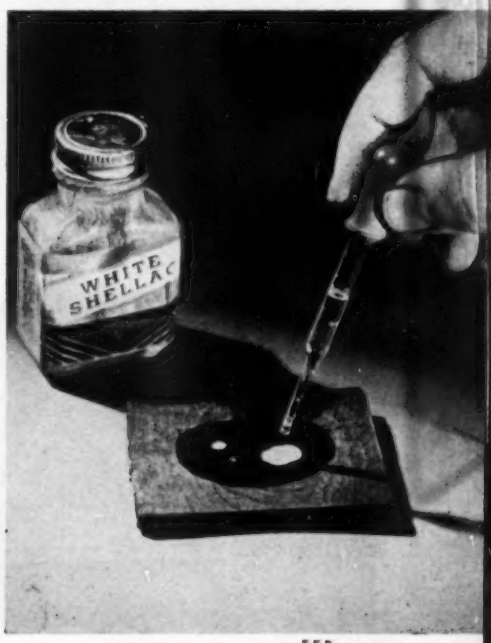
Colloidal Prussian blue was once an important writing ink, but aniline dyes are now more commonly used.

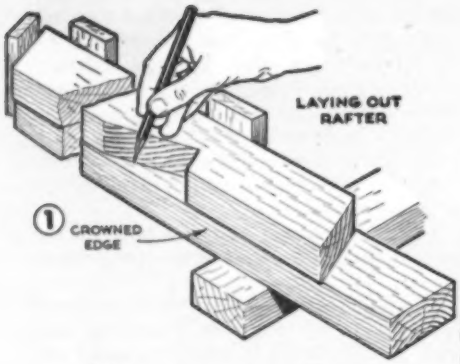
Colloidal particles may often be produced by diluting a solution containing some solid with another liquid in which the solid will not dissolve. By pouring an alcoholic solution of sulphur, for instance, into water, a milky sol of sulphur can be formed. The whitening of newly applied shellac by drops of water is another example, the water diluting the alcohol in which the shellac resin is dissolved. As the resin will not dissolve in the water, it is precipitated as colloidal particles that disperse light and look white.

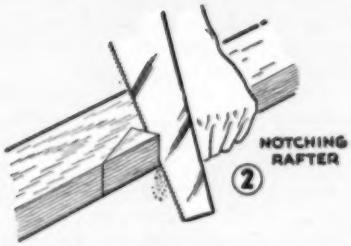
If you pour a dilute solution of oxalic acid over the big particles left on the filter in the experiment at left, they will break down into particles of colloidal size and pass through the filter, as seen below. This process of breaking and dispersing particles is called peptization.



If a solution containing a solid is diluted with a liquid in which the same solid will not dissolve, colloidal particles are often produced. Here is a familiar example—the spots formed when water drops on shellac.

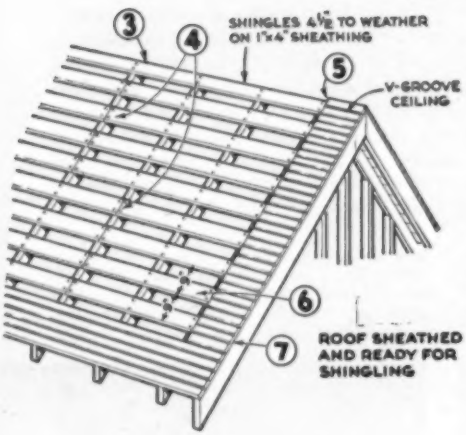






What's Wrong?

SEVEN errors in building a roof are shown in the three drawings here—one each in the drawings above and five in that at the left. The points at which to look for errors are numbered. When you have decided on what you consider wrong, turn the page upside down and compare your answers with those given below.

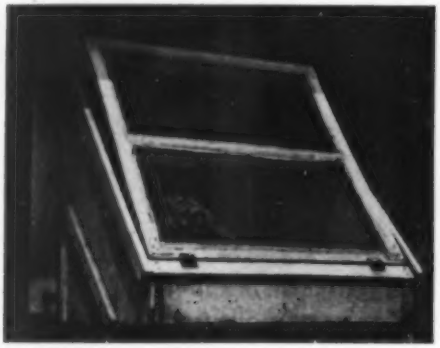


ANSWERS

1. Since rafters are laid crowned edge up, the piece being marked for notching should be turned over.
2. Make the rip cuts first so the waste will help support the saw.
3. A filler strip must be nailed at each side of the ridge to provide solid nailing for rip-rap or other trim.
4. Joints should be staggered with no more than two together.
5. About half the ceiling boards should extend to the second rafter for more support for the barge board.
6. Spacing on 4½" centers permits uniform shingle nailing and extends shingle life.
7. The shingle molding is missing.

Greenhouse in Cellar Window Gives Seeds Start in Late Winter

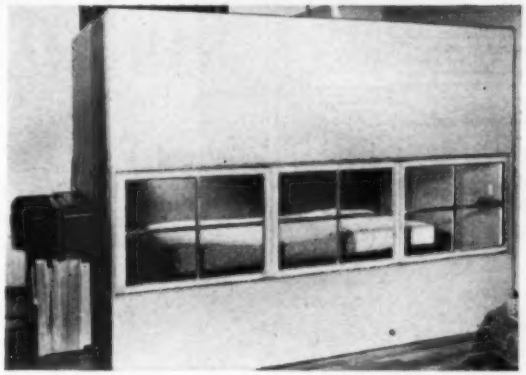
ADJOINING a basement window on the south side of a house, this glazed seedling box gets warmth both from the cellar and the sun. If a window sash is on hand, the box frame may be built of 1″ by 2″ stock to fit it and the casing on which it is to be used; if not, a suitable sash frame may be made of 1″ by 2″ stock and glazed.



Notch the frame to fit snugly over the sill so that when the box is screwed to the casing most of the weight will be on the sill. The box can be lightened by making the bottom of plywood or composition board. A lattice shelf may be installed, but don't make it so deep it will keep sun from pots at the rear. Apply weatherstrip along the casing and window joints.

The hinged sash can be raised and the window closed on warm days. Use hinges with removable pins and take the sash off when the box is stored.—A. F. STILSON.

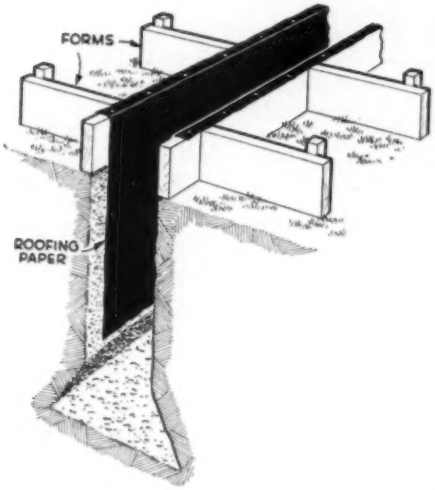
Sleeping Cubicle Has Air Filter for Allergy Sufferers



PERSONS who suffer from hay fever or asthma can frequently lessen the attacks by sleeping in an atmosphere free of dust and pollen. Equipped with a ventilator and filter, the cubicle shown here provides such sleeping quarters for a child who is allergic to household dust.

At the same time it leaves the rest of the bedroom free for other uses. In summer, the ventilator, placed in a bedroom window, blows outside air into the cubicle through a hole in its wall. In winter, this hole is closed, another opened, and the ventilator placed to blow bedroom air through it into the cubicle. Windows prevent a shut-in feeling.

Framed with 1″ by 2″ pine, the cubicle is 5′ wide, 6′ high, and 8′ long, hard-finish wallboard being used inside for quick cleaning. Built in sections fastened together with screws, the room may be easily taken apart. Bottom edges of the walls are felted so the entire cubicle may be moved around. It has no floor. Space must be left under the door or elsewhere to allow air leakage from the cubicle.—WILLARD ALLPHIN.



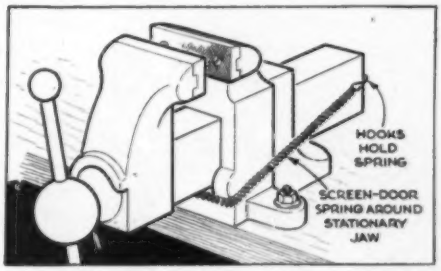
Roofing Paper Provides Seal When Pouring Foundation

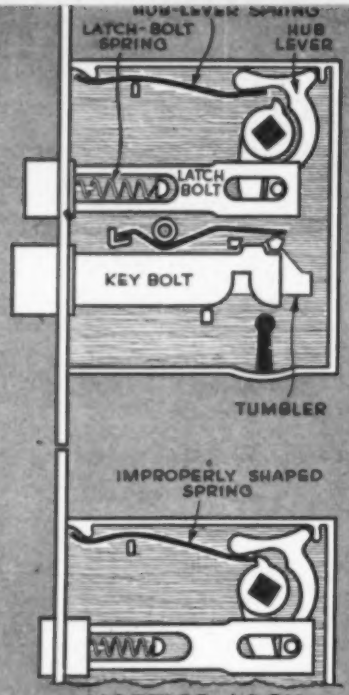
FOUNDATIONS for small buildings frequently are made by pouring the concrete directly in a trench, usually 12″ wide and 3′ or 4′ deep. A form is needed, however, to retain the portion above ground, and at this point difficulty may arise if the ground is uneven, for the concrete leaks between the earth and the bottom edge of the form.

Roofing or building paper nailed to the top of the forms and allowed to hang down the sides of the trench makes an excellent seal during the pouring. It also permits easy removal of the forms and greatly improves the appearance of the finished work. Only that portion of the paper above ground is removed.—HENRY HANSCOM.

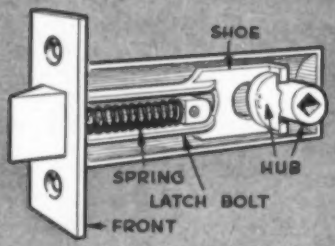
Spring Overcomes Lag in Vise

AFTER long use, the screw threads of a vise often become worn and the jaws are insensitive to small movements of the handle. This lag may be overcome by stretching a screen-door spring around the stationary jaw and hooking the ends to the rear corners of the slide. Two springs may be needed on a large vise.—ANDREW VENA.

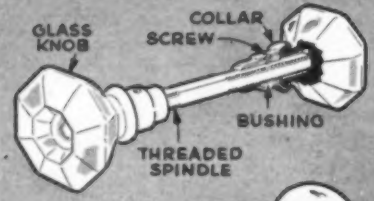


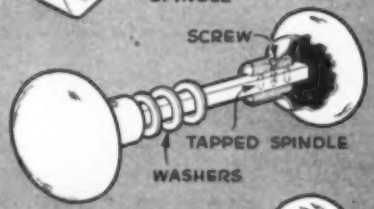


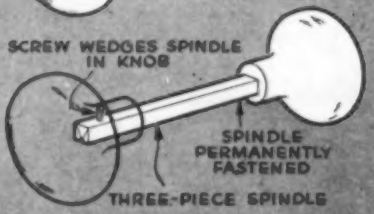
MORTISE LOCK



TUBULAR LATCH







Turning Old

By CHARLES KIMBALL

ONE good turn of a doorknob deserves a ready response. If you don't get it, the knob or its spindle may be binding, the knob screw loose or lost, one of the latch springs broken, or the mechanism gummed with oil—all faults that can be corrected without resort to a locksmith's services.

Knobs sometimes stick because they have been set so close together that the ends of the shanks bind against the roses or escutcheons. All that is necessary is to remove one knob screw and set the knob back far enough for the screw to go into the next spindle hole. Spindle washers may be required to get the right adjustment between knobs.

Occasionally when plates are installed, the roses are out of alignment with the center of the hub in the lock, causing the spindle or the shanks to bind. Removing and resetting the plates is the remedy.

A knob may pull or fall off when the screw that holds it on the spindle is loose or missing. If the screw has been lost, a setscrew having the proper thread may be substituted or the knob and spindle taken to a locksmith or hardware store and fitted with another knob screw of the proper size.

Sometimes an old knob screw won't tighten because of damaged threads, and a new one can be put in. If the new one can't be tightened, the threads in the spindle are damaged or worn. Retapping may fix that; both knobs may be adjusted over a new set of holes, one end of the spindle being sawed off, if necessary, to fit its knob; or a new spindle may be required. Modern locks take spindles of a few standard sizes, and hardware stores carry an assortment.

One quick remedy is to coat the threads of a loose screw with shellac, lacquer, or fingernail lacquer. In this event, when the screw must be removed again, it may be necessary to let a little solvent, such as alcohol or fingernail-polish remover, soak onto the threads. Penetrating oil brushed on stubborn, rusted screws may loosen stuck threads. The treatment may be required for several days in succession. As a last resort, the knob shank may have to be heated with a blowtorch. A mask cut from tin-can stock to fit snugly around the shank will protect the door and plate if both knobs are stuck and the heating has to be done while they are still in place on the door.

Knob screws that have been burred by a screwdriver should be smoothed with a small file, or cut fingers may result. When a knob is screwed to a spindle, the screw hole in the shank should be above the horizontal no matter which way the knob is turned. In this position the screw is less likely to drop out if it works loose.

DOORKNOBS Into New

A pair of knobs will rattle and slap against the plates when they are spaced too far on the spindle. Loosen one and move it a hole nearer the door or put washers on the spindle to take up the slack, dividing them evenly on both sides. If the spindle is threaded, loosen one knob screw, turn the knob clockwise to adjust it, and retighten the screw. One or two washers may be needed to keep the screw on top.

When a knob turns without working the latch, it is probably on a threaded spindle and its screw has worked loose. A glass knob under severe usage may work loose from its metal collar and can be repaired, if the bushing is open at both ends, by tamping in iron cement. For a door of average thickness, one end of the spindle will have to be sawed off before reassembling. Glass knobs with bushings closed at one end can't be repaired. A hollow cellulose-acetate knob may pull free from the metal bushing on the spindle and will have to be replaced.

In mortise locks with two springs in the latch-bolt mechanism, a hub-lever spring sometimes breaks with the result that the latch-bolt spring will return the bolt but feebly to the outer position when the knob is released. To replace the spring, remove the spindle and unscrew the lock at the edge of the door; then press a screwdriver into the spindle hole and pry out the lock. Take care not to spill out the loose parts.

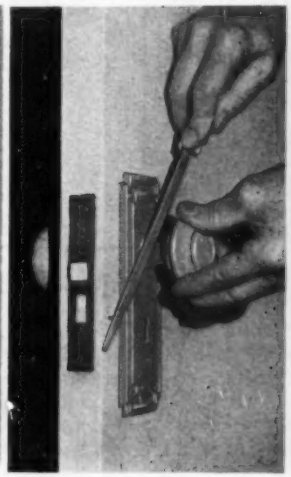
The knob of a lock equipped with a free-action latch mechanism sometimes fails to unlatch fully when turned toward the jamb stile but operates the latch bolt perfectly when turned toward the hinges. This is caused by a hub-lever spring interfering with the upper cam of the hub. The spring should be rebent properly or shortened.

Sluggish action may be due also to lubrication with oil, which collects dust and becomes gummed. A sticking lock must be removed from the door and soaked thoroughly in a solvent. Work it a few times with a screwdriver in the hub and the key in the keyhole, drain out the cleaning fluid, and dry. Then lubricate with powdered graphite. Locks and latches should be lubricated periodically with graphite blown in at the retracted latch bolt and in the keyhole.

Tubular latches, often used on inside doors, are an exception to the graphite-lubrication rule. Most makers recommend petroleum jelly for the bolt mechanism.

Simply tightening the screw will often cure faulty operation of a knob. Screws kept above center are less likely to fall out.

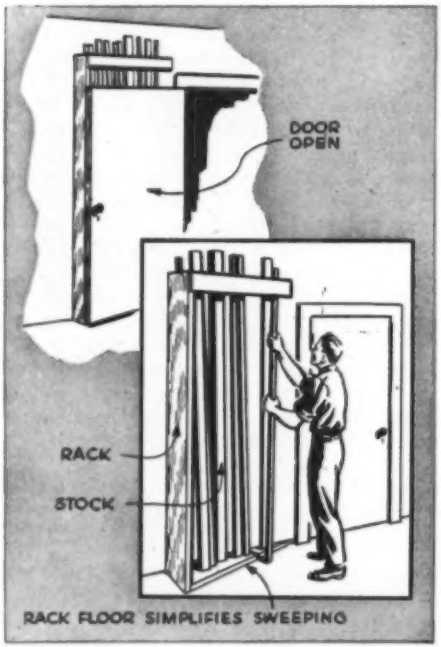
Knob-screw heads that have been burred by a screwdriver can cut or scratch a finger if they are not smoothed off with a file.



Graphite is the lubricant used in mortise locks. Puff it in while the latch is retracted. Oil gums and makes a latch sluggish.

Wedge-Shaped Storage Rack Uses Waste Space Behind Door

When wall and floor space is at a premium, you can utilize normally wasted areas in the shop with storage racks similar to the one below. This type of wedge rack can start right at the door jamb and work out into as wide or narrow an arc as the normal door swing dictates. For such long, narrow stock as pipe, the arc can be limited to a size that will cause no interference with the full movement of the door.

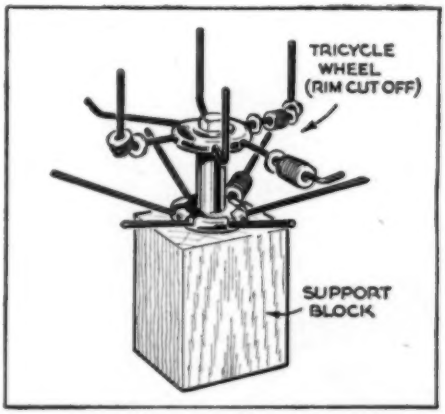


Pin Puts Life in Lighter Wick

Windproof lighters often fail to work when the wick spreads or lies against the shield. This can be prevented by cutting the head off a common pin and pressing the pin down through the wick to support it upright. Besides igniting more surely, a wick so supported will also last much longer.—Don Leibenguth.

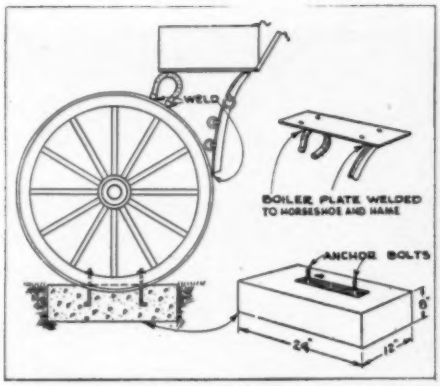
Emergency Belt for Power Tools

Emergency replacement of a worn-out V-belt can be made with a length of sash cord. Place the cord over the two pulleys and join the ends with as small a knot as possible. Wrap the joint with friction tape, as shown above. The improvised belt will seat itself with the knot on the outside, and will give good service until a regular belt can be obtained.—Ken Murray.



Rack Made from Tricycle Wheel

Bolted by the hub to a support block, the center portion of a wheel from an old tricycle or baby carriage makes a rack for holding washers sorted in sizes. The top row of spokes should be bent upward so washers won't slide off.—Louis M. Goodman.



Wagon Wheel Supports R.F.D. Box by the Side of the Road

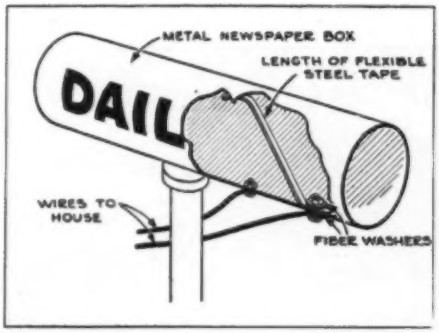
ANCHORED to a concrete block set in the ground, this wagon-wheel mailbox support brings a pleasantly old-fashioned note to the rural home near which it stands.

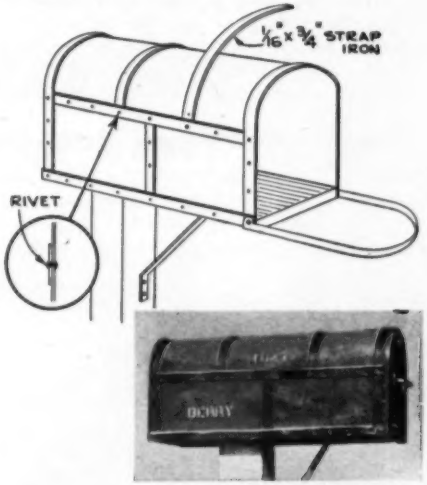
A horseshoe and hame serve as brackets for the piece of boiler plate to which the box itself is bolted. Located so as to bring the box level, the horseshoe and hame are welded to both the tire and boiler plate. The anchor bolts, embedded in the concrete, pass through holes drilled in the rim and keep the wheel rigid. While the wheel may be painted, it looks fine if left in a natural, weathered condition.

Signal Light in House Shows Newspaper Has Been Delivered

WHEN I want to know whether the daily paper has been delivered in the cylindrical metal box down the hill from my home, I press a doorbell button in the house to see if a small light comes on. If it does not, I know the paper is in the box.

The switch, light, and a 6-volt battery are wired in a circuit stretching between the box and house. Normally, a length of flexible steel tape attached to an insulated terminal makes contact with the box, giving a complete circuit and lighting the lamp when the button is pressed. Putting in the paper breaks the circuit.—GEORGE ZINSERLING.

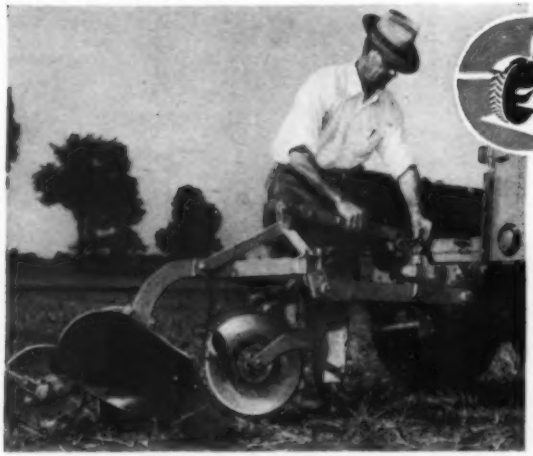




Mailbox Looks Like Old Trunk

IF YOU are tired of looking at the plain lines of a standard rural mailbox, it can be made more interesting by riveting on strap iron to suggest one of the old round-top trunks common in grandpa's day.

To carry the illusion still further, paint the box a light tan before installing the strap iron, paint the straps black, and stencil the name in white. Copper rivets evenly spaced will increase the effect.



FOR EASIER FARMING

New Hydraulic Lift Unit for Jeep Facilitates Work on Farm

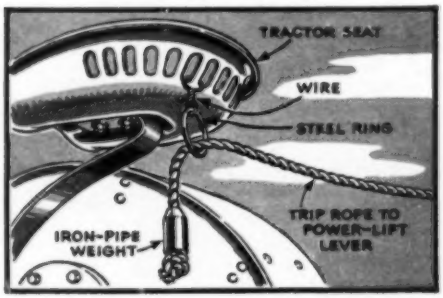
When attached to the underside of a jeep, a new hydraulic lifting unit now on the market makes it possible for a farmer to raise or lower a plow or other farm implement hitched to the jeep simply by touching a dashboard button. A hydraulically activated piston operating the extension bracket to which the hitch is made may be seen under the rear of the jeep, at left above. Power is provided by a pump located directly in front of the oil filter and driven by an extra belt from the crankshaft. Known as the Love Hydraulic Lift System, the unit is distributed by the Newgren Co., Toledo.

Varied Attachments Make Garden Tractor a Jack-of-All-Jobs

Although intended primarily as a lawn mower, a hand tractor now being produced by the Lodge & Shipley Machine Tool Company, of Cincinnati, has attachments for performing such other jobs as cultivating the garden, planting seeds, and clearing snow from a walk. The manufacturer also plans to offer a small plow for the tractor.

Coupling Saves Tractor Rope

If you are accustomed to tying the trip rope to your tractor seat, this arrangement will be an improvement. Then, if you forget the rope when you uncouple the tractor and drive ahead, the rope will not be broken or the power-lift lever bent.—Ray Harrison.



JUDGE BROWN'S CAR
was
must be ready at nine!
Judge Brown is a fine man and I sure wanted to help him out.
But his old car, with 87,000 miles on it, had certainly seen better days. For one thing, she was really pumping oil.
He said, "Now, Frank, I've just got to have it Wednesday morning for a case in Kirby."
Boy, I really slaved over that car. Pulled the motor down, ground the valves, put in a set of Perfect Circle Piston Rings, new gaskets, and other things she'd needed for a long time.
Then I "sewed her up," so to speak. I certainly felt as though I'd just performed a major operation —and I had!
Well, the way that car ran was a pleasant surprise to the judge. He should have brought it in long before he did and saved himself a lot of needless trouble and expense.
Anyway, that's my job. They call me a Doctor of Motors . . . and I guess I am.
NOTICE TO CAR OWNERS
Perfect Circles are available at every automotive repair shop. Your favorite mechanic—your Doctor of Motors—recommends them.
THE PERFECT CIRCLE COMPANIES, HAGERSTOWN, IND., and TORONTO, ONT.
Your Doctor of Motors restores power . . . saves gas . . . saves oil with . . .
PERFECT CIRCLE
PISTON RINGS

NEW!

NO. 77 X-ACTO WOODCARVING SET

Contains:

6 different chisel and gouge blades, scalpel-sharp, of high carbon surgical steel. Flat, "U" and "V" shapes.

4 assorted regular blades.

2 three-inch blades.

1 specially designed handle, to take all blades.

Complete, with hardwood block and transparent acetate cover . . . Only **$3**

THE PERFECT TOOLS

for carving wood, plastics, linoleum or what have you—with special rigidity for heavy cutting

This is it! The sweet and handy set you woodcarvers, model builders and artists have been clamoring for . . . the super-topnotch job you expect and get from X-acto.

Six scalpel-sharp, new chisel and gouge blades, each a different shape, each designed with an ingenious architectural rib in the tang end to give you the special rigidity you need for deep cuts, curves and angles. Plus a half-dozen other X-acto blades and a specially designed X-acto handle into which all blades fit interchangeably.

What versatility! You can use this new No. 77 for anything from a life-size statue to a tiny scale-model plane . . . and know you'll do a better, quicker job, *as always* with X-acto!

Have you seen

"The Big Shot?"

It's got everything! Knives, plenty of blades, specially designed hobbycraft tools for every exacting job. Contains: 3 X-acto Knives; complete assortment of blades; stripper; sander; planer; saw; drills and holders; ruler. Complete in desk-drawer size wooden chest **$12.50**

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*Reg. U. S. Pat. Off.

Far from Broadway . . . Arthur Hammerstein Keeps Young . . . and Busy . . . in his Atlas Equipped Shop

With the beautiful melodies of his 31 musical triumphs still echoing, famed producer Arthur Hammerstein, at 73, continues an active vigorous life on his 300 acre dairy farm near Chicago.

His love of tools carries over from boyhood days in his father's shop. Now he is happiest in his Atlas-equipped workshop, repairing farm and home equipment and working on unique inventions, which include a non-clogging salt shaker soon to be sold nationally.

For practical relaxation after busy days, or an interesting hobby with future commercial possibilities, nothing quite compares with a home workshop. And you'll find Atlas industrial tools ideal for such a shop — *compact, powerful, accurate, and low cost.*

They help you master any machining need that develops as you repair home equipment or work on ambitious projects. Ask your Atlas distributor to give you the complete details about their many performance features.

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An interesting collection of photographs and stories of men who built businesses of their own with Atlas tools. Send for your copy today. Atlas Press Company, 255 North Pitcher St., Kalamazoo 13D, Michigan.

Atlas 4 TOOL TEAM

A "SMOOTH SHAVE" FOR SOFT METALS

YES, the Nicholson or Black Diamond Lead Float File actually "shaves" thin slices from such extra-soft metals as lead and babbitt. Its coarse, short-angle teeth or "blades" cut away stock rapidly under normal pressure. Yet the same file—used with a lighter touch—produces a smooth finish.

Lead Float files are made in both Flat (rectangular cross-section) and Half Round shapes. In the above illustration, the Half Round back of a Lead Float file is being used to smooth up the concave edge of a babbitted bearing. This shape is also useful in reaming lead-pipe fittings and finishing off solder joints.

Nicholson or Black Diamond Lead Float Files—both Flat and Half Round—are widely used by industrial plants and machine shops on soft bearings and moulded parts; and by plumbers and home craftsmen.

FREE — 48-PAGE BOOK —"FILE FILOSOPHY"

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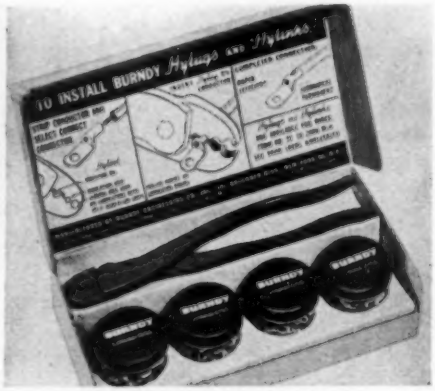
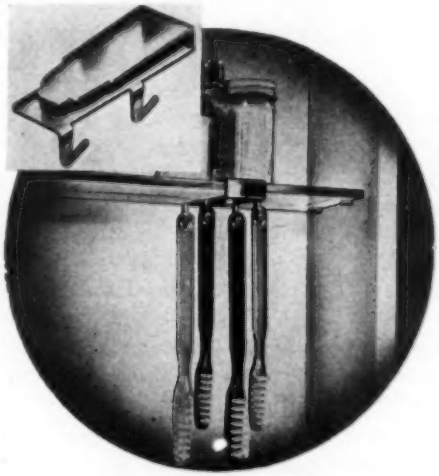


Solderless Connectors Stay Put

A KIT containing 325 assorted solderless connectors for electric wiring has been placed on the market by the Burndy Engineering Co., of New York City. The package holds a tool for installing the pure-copper joints. The connectors, which fit No. 10 to No. 20 wire, are constructed in one piece and will not come loose when they are fastened to a conductor.



Novel Toothbrush Holder

THOSE who like the family toothbrushes kept out of sight should be interested in the new Prim holder (inset at left, above). The aluminum clip is designed to slip over a shelf inside the medicine cabinet, as shown above. The holder has four hooks on its underside and a flat top.

TOUGH

BUT OH SO GENTLE

When your car *first* begins to use too much oil, that's when you need new piston rings. And it will pay you to get Hastings rings. They stop oil-pumping, check cylinder wear, restore engine performance. Your service man —your motor specialist—will tell you it's the best money you can spend on your car.

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PISTON RINGS

TOUGH ON OIL-PUMPING GENTLE ON CYLINDER WALLS

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MOTOR RYTHM

and start faster in cold weather!

Pour a pint of MOTOR RYTHM into your crankcase *now*—add a pint with every oil change—and be sure of fast, easy starting on the coldest day! Save your battery, save your car, save your temper—a touch on the starter and the coldest motor springs to life with MOTOR RYTHM in the crankcase! Ask for MOTOR RYTHM at your garage or service station. *R. M. Hollingshead Corporation, Camden, N. J.; Toronto, Canada.*

Whiz

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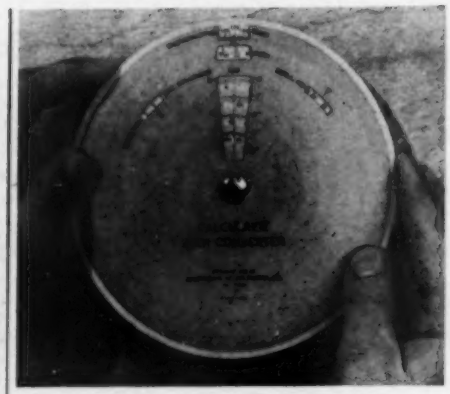
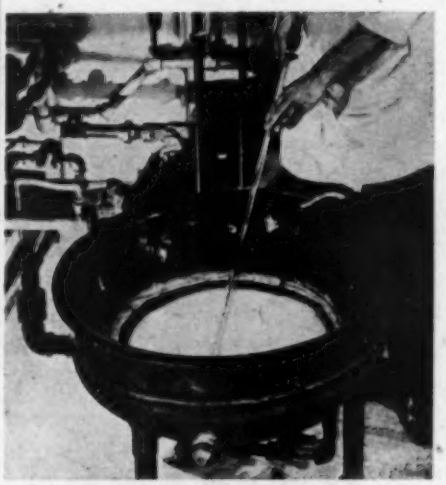
LEADER IN MAINTENANCE CHEMICALS



Speeds Linear Conversions

TIME lost translating fractions of an inch into decimals, or inches into millimeters, can be cut by the Calculaide converter. With a range from 0 to 100 mm., its decimal equivalents are graduated at .001 inch, its metric ones at .1 mm. Besides linear equivalents, it carries corresponding gauge numbers from No. 3 through No. 30, plus drill numbers from No. 1 through No. 60.



"Cooking" Chemicals for Tubes

IN THE pot above, chemicals are being cooked in a steam-heated, glass-lined kettle before being converted into screens for cathode-ray tubes. To assure purity, the North American Philips Co. phosphor laboratory in which the pot is used has an electrostatic precipitation system to purify the air.

Evinrude announces the revolutionary new

Weedless Drive

Now you can enjoy a new "freedom of the water". Drive full power, non-stop, through thickest reeds or dense carpets of water hyacinth or lotus. Slash confidently through water growths you would not dream of tackling with any conventional drive. Go where you wish . . . catch more fish where fishing's best!

Fully tested and amazingly effective the WEEDLESS DRIVE is the result of long experiment to perfect a drive equally efficient in weeds *and in open water*. Tremendously rugged . . . built to take the banging over rocks and dead heads. Equipped with new type propeller slip clutch that practically eliminates need for shear pin replacement.

The WEEDLESS DRIVE is now standard on two of Evinrude's most popular light motors, Sportsman and Sportwin. See your Evinrude dealer — look for his name in your classified telephone directory under "Outboard Motors." The Evinrude catalog is free—send for your copy today.

SEND FOR FREE CATALOG — Complete catalog of 7 Evinrude models sent free — write for it today! EVINRUDE MOTORS, 5434 N. 27th St., Milwaukee 9, Wisconsin. *In Canada: Evinrude Motors, Peterboro, Ontario.*

WORKSHOP WISDOM

Laminating waste stock for turning

MAKE use of your waste stock by laminating scrap pieces with CASCAMITE, because it's *strong, stain-free,* and *highly water-resistant.*

To laminate waste stock

Choose pieces of stock to roughly approximate finished size and shape. Plane surfaces to be glued so that they are perfectly smooth. Spread a thin film of CASCAMITE on the surfaces to be glued. Clamp and let set (at 70°F. or warmer) until glue is hard.

CASCAMITE is also recommended for laminating stock for table and chair legs, banisters, deep wooden bowls—wherever large dimensions discourage use of solid stock.

A "cinch" you'll prefer—CASCAMITE

Easy to mix. Just add CASCAMITE to cold water and stir.

Strong. CASCAMITE forms a bond stronger than the wood itself.

Thrifty too! Mix CASCAMITE as you need it. No waste.

Get CASCAMITE urea-resin glue—and CASCO, the standard casein household repair glue, at your hardware store in 10¢, 25¢, and larger sizes. For outdoor and boat work, use CASCOPHEN, the new, completely durable, waterproof resorcinol-resin glue.

FREE GLUING GUIDE containing complete gluing directions plus helpful hints for household repairs. Free on request. Address a post card to Casein Company of America, Dept. P3-27 350 Madison Avenue, New York 17, N. Y.

CASCAMITE

Dry Powder Urea Resin Glue

You'll be amazed by the sensational new mortar-like repair cement, that's so easy to use. Mixed only with water, X-Pandotite can be applied with a putty knife, or table knife. It's the permanent fixer for cracks, joints, loose fixtures, tile and 1001 other things that need repairing. For anchoring and molding purposes: X-Pandotite can be colored before using; stained or painted after hardening.

X-Pandotite is sold at leading hardware and paint stores at 35¢ for a ½ lb. can—60¢ for a one lb. can.

If your dealer can't supply, send 50¢ for a ½ lb. or $1.00 for 1½ lbs. to the X-Pando Corp., 43-15 Thirty-Sixth St., Long Island City, N. Y.

The X-Pandotite will be sent prepaid.

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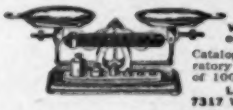

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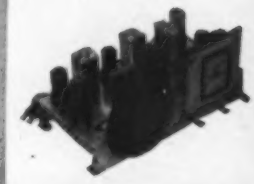

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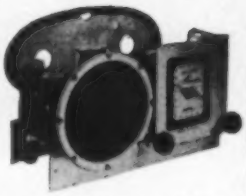

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You want three things in your workshop handgrinder — POWER; CAPACITY; FLEXIBILITY. Look how you get these in the New Dumore Duplex! Powered with the famous Dumore motor, full 1/14 HP, to handle "heavy" jobs. Equipped with ¼" chuck for extra capacity. Practical attachments to convert instantly for bench, lathe, and flexible-shaft work. Think what you can do with this extra power, capacity, and flexibility, in wood, metal, and plastics! Easier, better, faster work — twice the fun — and at no higher price than an ordinary handgrinder!

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You can do a countless variety of jobs with the Duplex—sanding, sharpening, grinding, sawing, and many more. Its chuck takes tools with ¼", ⅛", and 3/32" shank — ordinary handgrinders usually handle only up to ⅛" shank tools. A full 1/14 HP motor has plenty of power for heavier jobs. Long-life bearings guarantee trouble-free service.

The Deluxe Duplex Grinder Kit (illustrated above) includes the Duplex Grinder and 27 different tools and accessories, packed in a permanent case of handsome polished wood. Complete as described—$27.50. Standard, 9-accessory kit, without case—$19.75. With a simple, easy-to-use attachment your Duplex becomes a flexible-shaft tool. Write for information on this kit, and other attachments which convert the Duplex into a lathe- and bench-grinder.

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Take advantage of our 10-day Trial Money-Back Guarantee — prove to yourself that the Duplex Grinder is the best hobby-tool value on the market today. Production is still too limited to stock your dealer, but while the supply lasts, we can accept direct orders for immediate delivery.

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Single-Tube Radio Set

For youngsters who want their own radios, Laco Products, Inc., of Los Angeles, has designed Kitcraft Model 200, a one-tube detector and amplifier set. The radio is built around a miniature 1L-4 high "mu" pentode tube and will operate on a single cell for the filament supply and from 22½ to 90 volts for "B" supply.

High School Photo Contest Offers $3,500 in Awards

Prizes totaling $3,500 will be distributed in five classes of competition in Eastman Kodak Company's second annual National High School Photographic contests, which will open Feb. 15 and run through May 15.

Ninth through twelfth-grade students of public, private and parochial schools are eligible. Only black-and-white pictures taken since May 15, 1946, will be accepted.

Model Builders Attention!

	V	V-2	V-3
Hex	½"	⅜"	5/16"
Thread	⅜"-24	¼"-32	¼"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3½	2½

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Silimant sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

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AMERICA'S FAVORITE SPARK PLUG

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"The enclosed photo shows 18 bass and one crappie we caught on your No. 2 Hawaiian Wigglers from Lake Blackshear near Cordele, Georgia. The bass weighed from one to three pounds and were taken on opening day. In the picture left to right—Crompton Blankenship, myself and Hubie Leftwich. All of us enjoy using Hawaiian Wigglers. They sure get results."—*Franklin Martin, Marietta, Georgia.*

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Shallow Running
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Contains many interesting letters and photographs of catches made with Hawaiian Wigglers, Jitterbug, my famous surface bait, and my new Hula Dancers.

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Improved **MOTO-TOOL**

"MAN . . . WHAT A POWERHOUSE!"

A TOOL THAT PACKS YEARS OF PLEASURE

Here's a tool to please a man's heart. A gleaming "powerhouse" that holds promise of endless creative hours. This "pocket-size machine shop" is a war veteran . . . used by all branches of the armed forces in far flung repair bases . . . and it helped set production records at General Electric, Westinghouse, Remington Arms, Ford and other plants. Hobby enthusiast or expert craftsman . . . first choice is model 2 Moto-Tool kit, with its handsome, felt-lined, highly finished wood case . . . with rows of tools begging to be put to work. The usefulness of Moto-Tool for precision work is increased by two versatile attachments now available at slight additional cost (see below).

Look For These Moto-Tool Features

Housing has "pencil-type" finger grip. Instant-action, wrenchless chuck. Oil-less, sealed, trouble-proof bearings. Patented automatic chuck lock pin. Oversize armature shaft, hardened, ground and polished. 110 volt, universal type motor. Easily replaced commutator brushes. Sliding snap type switch. Handy hanger hook. Cord protector. Sturdy, shockproof bakelite housing. Dust-filtered, air-cooling system. Weighs only 13 oz. . . . shaped to fit the hand. Dynamically balanced for vibrationless operation.

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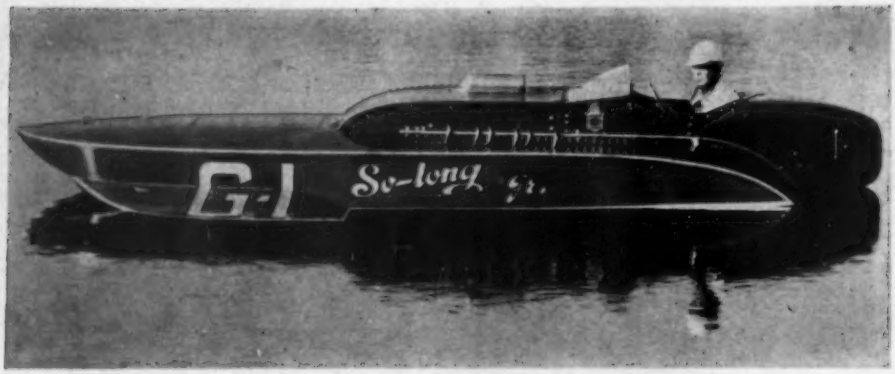

Bus Engine Powers Viking Cup Race Winner

Before L. J. Fageol, president of the Twin Coach Company, put a Twin Coach engine in his speedboat, the power unit, primarily used on buses, had been producing about 180 hp. at 2,800 r.p.m.

Fageol knew the engine was built to do better, so when he installed it in his speedboat *So-long Jr.*, he souped it up with dual carburetion and helped it along with a racing camshaft and a V-type marine drive. As a result, he got 275 hp. at 4,000 r.p.m. This was enough to plane his craft over the water at 72 m.p.h. to win the Viking Cup races on the closed two-and-a-half-mile New Martinsville, W. Va., course. He hit 100 m.p.h. in the stretches.

The Twin Coach engine's speed was five m.p.h. faster than that with which Guy Lombardo, band leader, won the Gold Cup races in Detroit. Fageol plans to give *So-long Jr.* a try at a world's speedboat record on Salton Sea, in California.

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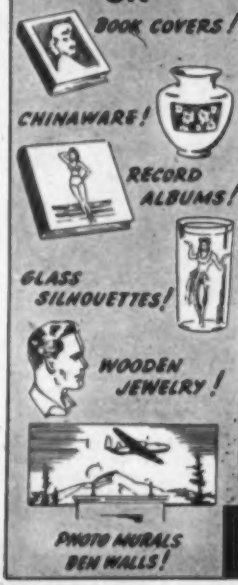

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feel SHARP
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with the SHARPEST edges ever honed!

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ENJOY BOXING FRIDAYS AT 10 PM EST OVER ABC NETWORK. GILLETTE'S CAVALCADE OF SPORTS ALSO AIRS WORLD SERIES AND OTHER CLASSICS YEAR 'ROUND.

Gillette Safety Razor Company, Boston 6, Mass.

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"Dead-Locker"

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DON'T SHOOT YOUR GAS-PUMP MAN!

He's doing the best he can. Sure, he knows how dangerous it is for you to drive your car . . . in stormy weather . . . with your dull old windshield wipers that smear and smear. He'd gladly put on for you quickly a pair of keen new ANCO RAIN-MASTER Wiper Blades and Arms. He has them—Newest Models! But he forgets to remind you? Too busy? You can't shoot him for that!

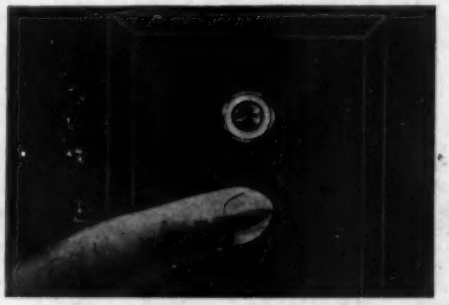
After all, it's *your* car to protect. So *you* remind *him*. Get RAIN-MASTERS . . . patented features . . . original equipment on many makes of high grade cars and trucks . . . used in war—on our fighting tanks and trucks and ships and bombers too...because ANCO RAIN-MASTERS clean quicker, clean cleaner . . . last longer. May save you a costly smashup.

Ask for RAIN-MASTER Windshield Wiper Arms and Blades next time you buy gas.

THE ANDERSON COMPANY
Established 1918
GARY, INDIANA

Decorative Window Frame

An interior window covering that permits a wide variety of decorative effects is produced by Robb-Hill, Inc., of New York City. The wooden Windo-Frame, which is sold unpainted, is adjustable in width from 39 to 45 inches and is 65 inches long.



Helps Find Things in the Dark

Easily attached to switches, door knobs or other objects, the Radi-Glo button made by the Lustrolite-Cleveland Corp., of Cleveland, eliminates fumbling around in the dark. A small plastic ring, it contains a sealed band of glowing material.

AMAZING NEW MAGNETIC JIG SAW!

READY FOR IMMEDIATE DELIVERY!

Model No. 2000

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For HOBBYISTS, CRAFTSMEN and LIGHT PRODUCTION

ONLY **$17.50** FOB FACTORY

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Complete with cord, 3 blades.

NO MOTOR NEEDED—JUST PLUG IN! PORTABLE . . . SAFE . . . CUTS CLEAN AND SMOOTH—NO SANDING NECESSARY!

ANNOUNCING a remarkable, PATENTED, MAGNETIC Jig Saw—better-performing, better-quality than famous PRE-WAR SYNCROS—now ready for immediate shipment anywhere! SYNCRO needs no belts, no gears, no oiling. No motor to buy. This high-speed, short stroke action, and freedom from belts, makes SYNCRO so safe even small boys and girls may operate it. Get this husky, powerful, 18 pound saw . . . so easily portable . . . you can use it anywhere—even on the kitchen table . . . so smooth-cutting no sanding is necessary! Cuts intricate designs on ¾" soft wood, ½" plywood and thinner hardwoods, plastics, thin metals. Leaves no ragged undersides on plywood or heavy cardboard. The rapid action blade cuts to the center of a 27" circle. SYNCRO is a rugged, powerful power tool for exceptionally high quality work but is not for ordinary lumber cutting. Ideal for hobbyists, craftsmen, light production. Perfect for models, displays, puzzles, inlays, silhouettes, toys, marquetry, games, what nots, etc. Order yours now on our 10 Days Money Back Trial offer—enjoy a lifetime of use!

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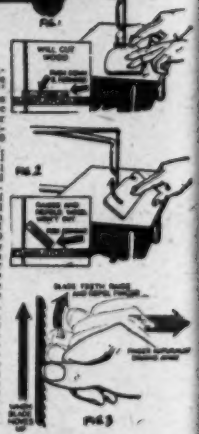
(1) WORLD'S SAFEST SAW. (2) PORTABLE . . . plugs in to 60 cycle A.C. 110-130 volt wall outlet. (3) NO ROTATING MOTOR NEEDED, SYNCRO'S self-contained magnetic power unit transmits A.C. magnetic impulses to armature diaphragm—power transferred to saw blade. COIL contains 1¼ lbs. No. 19 insulated copper wire, completely taped, impregnated, baked. Guaranteed not to burn out! MAGNET CORE contains 58 layers of metal. DIAPHRAGM of spring steel, heat-treated under special process, suspended on L-I-V-S rubber mounting cartridges. (4) 14,400 STROKES PER MINUTE! (5) NO RECIPROCATING OR ROTATING PARTS TO WEAR OUT! (6) NEVER NEEDS OILING. (7) TABLE TOP 10" x 10", a heavy, thick, durable alloy die casting ⅛" thick, ribbed base. Surface smooth for easy sliding. (8) BASE 7½" x 6¾" . . . a heavy, durable die casting. (9) ARM is of specially formed steel stamping ½" x 1". Return Spring of heavy duty steel. Guide Slide of plated steel and adjustable to varying wood thicknesses. Adjustment Screw permits easy, quick changes in length of saw blade stroke to compensate for voltages of 110 to 130 A.C. (10) THROAT CLEARANCE is 13½" permitting work on square sheet of wood, metal, plastic, 27" on the diagonal. (11) 5' cord . . . extension Underwriter's approved electric cable with molded rubber plug. (12) BLADES are 5" pin end style of finest steel, 18 teeth per inch. (13) NO-MAR, NON-SLIP RUBBER FEET. (14) DURABLE—will last a lifetime. (15) HIGHEST QUALITY—guaranteed by the trademark name "SYNCRO".

"Family Saw!"

"The Syncro Power Saw ordered from you in 1940 is still sawing merrily away. My son, (then 8) has used it in the attic, kitchen, his room, in the basement shop. I use it too. We never worry about accidents due to its Magnetic Safety Stroke feature. It's truly a family saw."
—Mr. B. H. Smith, Rexburg, Idaho

SAFEST!

SYNCRO has no continuous cutting blade so: "Long stroke" blade to *pull* fingers into *teeth*—*stead* there are 14,400 strokes per minute—7,200 shortcutting strokes plus 7,200 upward *Non-Cutting, Repelling* strokes! (Fig. 1) SYNCRO will not even *Cut* wood unless piece is pushed *Firmly Downward Against* blade and *Firmly Forward*—both actions at *Same* time! (Fig. 2) SYNCRO blade teeth *cut* Only on *Down* stroke. Teeth raise, repel, push away any object on *Up* stroke. When blade moves *Up* it *Kicks* finger away free. (Fig. 3) On down stroke, blade does not move *far enough* to accidentally cut finger unless finger is *intentionally, deliberately* fed into blade like wood is fed in Figure 1. No wonder SYNCRO is the world's *Safest saw* . . . a feature old and young users acclaim!



ORDER on 10 DAYS TRIAL!

So you may order with complete confidence, read this SYNCRO TRIAL OFFER: When you get your saw, plug it into any 60 cycle A.C. 110-130 volt outlet and saw according to instructions. Then, if it does not satisfy you perfectly in every way, return it postpaid within 10 days of delivery date, and we will refund your $17.50 promptly without questioning. Order now.

HOW TO ORDER—DO IT NOW!

Mail Coupon with Postal Note, Money Order or check for only $17.50 plus Parcel Post or Express Carrying charges . . . or . . . send $17.50 only and we will ship saw collect for Parcel Post or Express Carrying charges only. Specify type of delivery on Coupon. Shipping weight, packed, 18 lbs. Hurry! Act promptly—order—we'll ship same day order is received. (No complete COD orders accepted.) Add state sales tax (if any) to saw price.

SYNCRO WORLD'S SAFEST SAW

SAW CORPORATION
DEPT. B-27
ROCHESTER, MICHIGAN

EXPORT ADDRESS: 120 WALL ST., N. Y. CITY
WORLD'S LARGEST MAKERS OF ELECTRIC JIG SAWS

SYNCRO SAW CORPORATION, Dept. B-27, ROCHESTER, MICHIGAN

(Export Address: 120 Wall St., N. Y. City)

Gentlemen: Here's my order for one SYNCRO MAGNETIC JIG SAW, Model No. 2000, Shpg. Wt. packed 18 lbs., $17.50 FOB Factory. Please send it complete with electric cable and plug, 3 blades, on your 10 Days Money Back Trial Offer. I enclose $17.50, plus state sales tax, if any, as payment. Please ship saw:

☐ Express charges collect or ☐ (Parcel Post) charges collect.
☐ Express, for which I enclose an extra $.....
☐ Parcel Post, for which I enclose an extra $.....

NAME.....

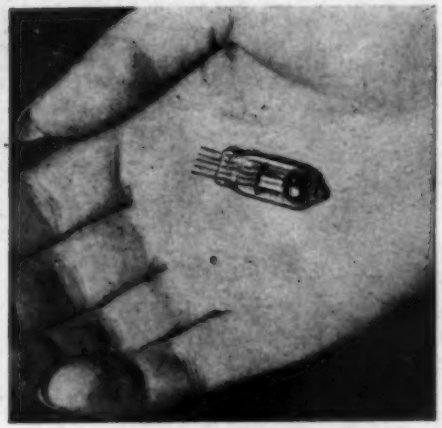
ST. & NO.....

CITY..... STATE.....

☐ I enclose no money—send FREE SYNCRO CIRCULAR.

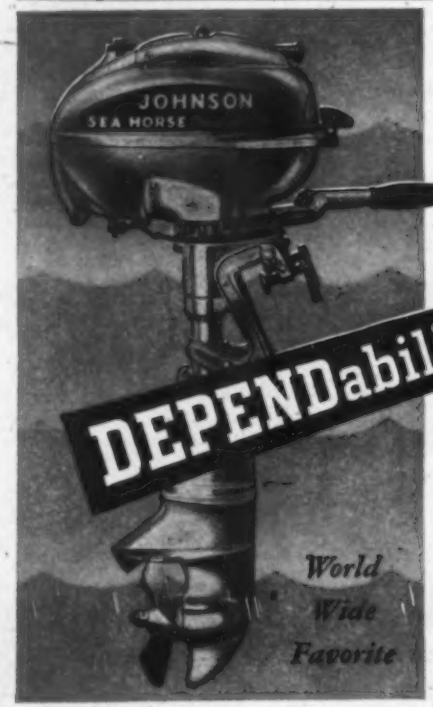
One-Hand Juice Squeezer

You can squeeze all the juice out of an orange with one hand tied behind your back with the new Juice-All extractor. The halved fruit is placed inside the cast-aluminum bowl and one downward stroke on the handle forces out the juice, which can then be poured from the lip on either side.



Tiny Tube for Hearing Aids

ONLY ⅝-inch long and ⅜-inch wide, tubes like this powered such war devices as walkie-talkies and mine detectors. Now their maker, Sonotone, is using them in hearing devices. Three of them go into Sonotone's latest instrument, which can be used for either low- or high-powered amplification.



JOHNSON is the outboard motor that leaves its wake around the world! Wherever men use boats the Johnson Sea-Horse is a familiar sight—because it is DEPENDable.

It offers users the simplicity and reliability of twin cylinder construction. It has all features that contribute to brilliant performance. Remember, outboard motoring's great improvements (Alternate Firing, Reverse, Dual Carburetion and others) are JOHNSON developments.

FREE HANDY CHART: New. Describes the 1947 line. Write for it. See your Johnson dealer about delivery. Look for his name under "Outboard Motors" in your classified phone book.

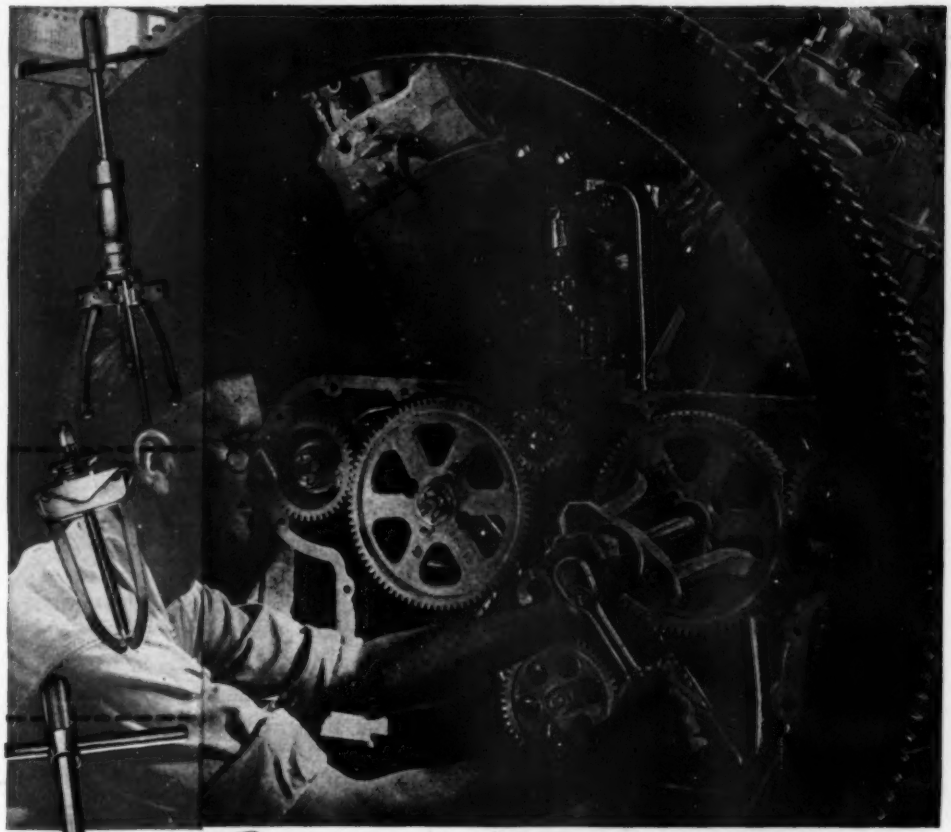
JOHNSON MOTORS, 500 Pershing Rd., Waukegan, Ill.

1947 SEA-HORSE MODELS

Small Alternate Firing Twin	31 lbs.	2.5 H.P.
Medium Alternate Firing Twin	44 lbs.	5.0 H.P.
Large Alternate Firing Twin	70½ lbs.	9.8 H.P.
Super Alternate Firing Twin	92½ lbs.	16.0 H.P.
Heavy Duty Opposed Twin	115½ lbs.	22.0 H.P.

All H.P. ratings above are O.B.C. Certified Brake Horsepower at 4000 r.p.m.

THERE IS NO SUBSTITUTE FOR EXPERIENCE



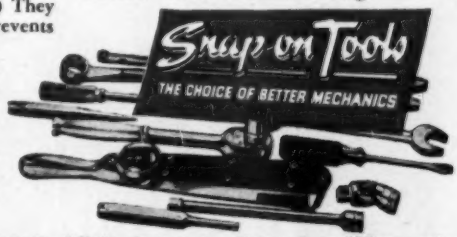
Snap-on Gear Pullers

give you safe, uniform power over entire range

On the testing floor . . . in maintenance operations . . . wherever there is a need for gear pullers, Snap-ons are favored by men who know good tools. There are four definite reasons for this popularity: (1) Snap-ons have more "locking power" for added safety. (2) They give you a "tip-less" pull that prevents binding. (3) You enjoy smooth uniform power for easy pulling over the entire range. (4) Snap-on pullers are available in a wide range of types and sizes.

You'll like the comfortable, well-balanced feel of Snap-on pullers. They have the ruggedness and stamina that make easy jobs out of the tough ones.

Snap-on pullers are part of a complete line of 4,000 tools available through Snap-on's nationwide, direct-to-user tool service. Write for free catalog.



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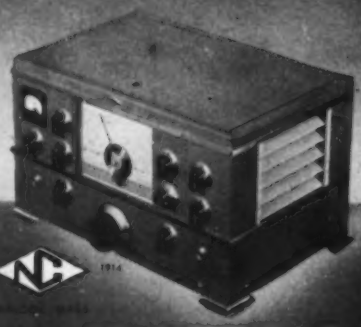
RANGE
RELIABILITY
RESEARCH

For the radio amateur, for the discriminating world listener, for the "Three Ex's" communication, the "Ham" operator, the "Hobbyist" and the "Experimenter" . . . the NC-2-40D is the ultimate in radio receiver. Assembled in the U. S. A. to bring you the most outstanding reception. Always, the quick, yet stubborn built in world wide reliability . . . proved by the record of National sets on three-fourths of the Navy's warships. Research . . . unending, never-ending, to bring you at last a thrilling new experience in radio reception. Hear the NC-2-40D for yourself. Write today for name of your nearest dealer.



NATIONAL
COMPANY, INCORPORATED
THE MOST DISTINCTIVE NAME IN RADIO COMMUNICATIONS

KEEP WARM! SAVE FUEL!

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BETWEEN YOU AND THE COLD

• A pliable, plastic weather-stripping, easily, quickly applied to windows, doors, baseboards. Stops expensive heat leaks. Keeps out dust and dirt.

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Roll covers about 80 feet, enough for 5 windows.

$1.25 *Higher west of Rockies and Canada*

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To Build Your Own Wagon, Cart, Toy, etc.

Sturdy, rubber tired, precision-made pressed steel wheels with red enamel finish. Ready to use axles—threaded at both ends. Acorn nuts supplied. Order today.

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4" Wheels, ¼" bearing, Steel Disc	$ .75
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6"x1.50 with ⅜" Selflube Oil Bearing	1.75
8"x1.75 with ⅜" Selflube Oil Bearing	2.25
AXLES, COLD ROLLED STEEL	
¼"x14" long, threaded both ends, Nickel Cap Nuts	.40
⅜"x16" long, threaded both ends, Nickel Cap Nuts	.60
⅜"x18" long, threaded both ends, Nickel Cap Nuts	.80

Sent postpaid in U. S. on receipt of price.

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PAINTERS' STRIPING TOOL

Easy to use as a pencil! Draws parallel lines, straights, curves, circles with paint, enamel, lacquer, etc. Do your own striping on autos, furniture, toys, bikes, model planes, signs, linoleum . . . make wall board look like tile. Painters—craftsmen, order today! Type "M" Master Painters' Striping Tool complete with tip for 1/16" stripe, $1.00. Extra tips 1/64", 1/32", 3/64", 1/16", 5/64", 3/32", 1/8"—75c each. Tool with complete set of 7 tips $5.00 (C.O.D. orders 25c extra.) Dealers write!

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Exclusive Safety Fingergrip for fine detail work

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Works Wood, Metal, Glass, Plastics

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Act Now!

Don't pay several hundred dollars more than necessary when you build a home! Buy it direct from our mill at our low factory price. We ship you the materials—lumber cut-to-fit, ready to erect. Paint, glass, hardware, nails, etc., all included in the price—no extra charges. Plans furnished—also complete building instructions. No wonder our customers write us that we saved them 30% to 40%. Prices subject to change without notice.

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Pictures wonderful homes in colors at money-saving prices. Designs to suit everyone. Send 25c for catalogue today.

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● Budget-conscious car owners find added pleasure in driving, after a re-ring job with Burd "Graf-Flox" Piston Rings . . . they appreciate the worthwhile savings of gas and oil. There's a bonus of fun from hearing the sweet sound of a smooth running engine, too . . . and from feeling the instant response at the touch of the accelerator. Try a set of Burd "Graf-Flox" Piston Rings . . . they're quicker-seating, longer-lasting because they're made of electric-furnace iron, precision finished and "Graf-Flox" treated. Mail the coupon today for two FREE booklets.

BURD PISTON RING CO.
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THIS COUPON BRINGS FREE BOOKS

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Gentlemen:
I'd like copies of your "Servicemen's Handy Handbook," which tells how to keep my car in good working order, and the booklet "No Job For A Dub."

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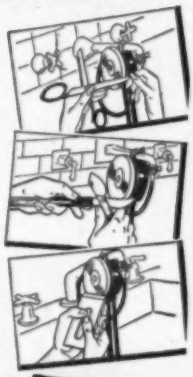
Another Quality Product from the House of Hudson

The HUDSON TURBO GRINDER

SHARPENS
Everything for Home and Shop



Simplest operation possible. Just attach to any ordinary faucet, turn on the water and the sensational patented Hudson turbo-jet impeller spins the wheel at more than 3,000 revolutions per minute—almost twice the speed of a standard electric motor. Adjustable to 10,000 RPM, depending on water pressure. Ideal for the handy man, housewife, hobbyist, mechanic, farmer. Precision built, quality throughout. Super-hard silicon carbide wheel. Stainless steel shaft. Chrysler Oilite bearings (never need oiling). All metal parts gleaming chrome. Colorful vinylite tubing.

Sharpens knives, scissors, skates, lawn mowers, wood planes, bits, chisels, axes, hatchets and all edged tools.

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Enclosed is a $8.95 ( ) check, ( ) money order for which rush to me, postpaid, one Hudson Turbo Grinder with full instructions for use. I understand the Grinder carries a full, money back guarantee.

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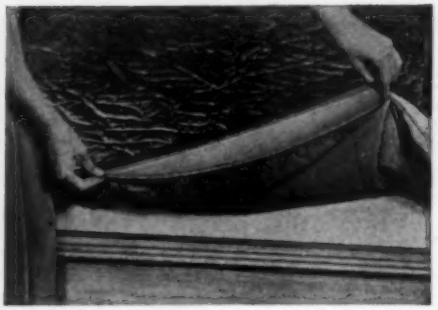


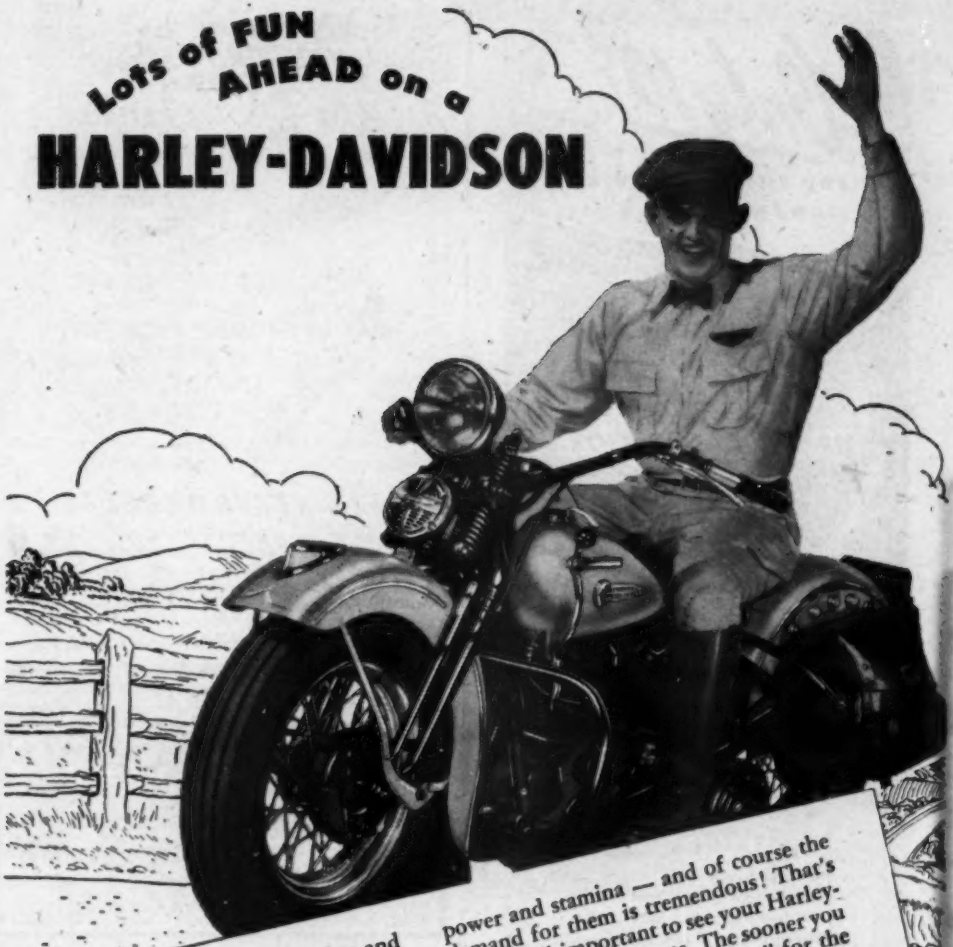
Electric Comforter Has Zipper

WHEN the rayon satin cover of Westinghouse's new electric comforter is ready for the dry cleaner, it can be removed by unzipping a 36-inch zipper at one end and untying several tapes that fasten it to the warming sheet it encloses. The warming liner is washable. The underside of the cover is made of slipproof spun-rayon faille. The control that sets the temperature for the electric comforter is housed in an ornamental box.

Radio for the Hard-of-Hearing

Two separate controls, one for a standard loudspeaker and another for listeners who are hard of hearing, are incorporated in the new Emerson table-model radio. A person with impaired hearing has only to plug into the radio and use a plastic ear receiver, which goes with the attachment. Volume can then be adjusted to the listener's wishes without interfering with the volume of the regular loudspeaker.

Lots of FUN AHEAD on a HARLEY-DAVIDSON



Sure thing — you want all the fun and excitement of motorcycling during the months to come! Life will be a continuous round of pleasure — when you own a Harley-Davidson. The new 1947 models have thrilling beauty, speed, power and stamina — and of course the demand for them is tremendous! That's why it's all-important to see your Harley-Davidson dealer *at once*. The sooner you do, the earlier you'll be "all set" for the thrill-packed good times of motorcycling!

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Motorcycles

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Please send at once free copy of 24-page "Enthusiast" Magazine, filled with motorcycle action pictures and thrilling stories.

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Only 10¢

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• This easy-reading GREENLEE HANDY CALCULATOR swiftly solves your woodworking problems. Just set the dial: convert linear feet to board feet; get slope per foot in degrees; compare hardness, weights, shrinkage, warping and working ease of various woods. More, too-bit sizes for head, body, thread of screws; nail specifications; tool sharpening hints; protractor. 6" diameter, fits your tool kit. Heavily varnished cardboard. Special offer Order now, send 10¢ (not stamps) in next mail. Greenlee Tool Co., 2122 Columbia Ave., Rockford, Ill.

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FOR THE CRAFTSMAN

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You don't even have to be handy with tools . . . just get an O'MALLEY FAUCET REPAIR SET . . . read the simple directions . . . and in a few minutes you can cure your faucet of its messy, water-wasting, nerve-devastating Drip-Drip-Drip. Costs less than a dollar, depending on the size you require, wherever hardware is sold.

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YOU Can Get This 2H.P. MOTOR SCOOTER! AS LOW AS $29.95

Assemble or build it—its easy! We can furnish factory built parts. 2 speeds up to 45 MPH! 100 M.P. gal. Easy riding—knee action and low gravity spring frame. Large 12" tires. *Streamlined.* **SEND ONLY $1.00** (cash or money order postpaid) (or pay postman $1.52 C.O.D. in U.S. only) for complete scale isometric picture blueprints (anyone can read them). 8 pages photo details, lists of factory parts prices for *both electric and gas models!* **FREE** with each order—big 48 page color book giving full details on over 100 other new inventions such as JET ENGINES—MIDGET MOTORCYCLES—ELECTRIC WELDERS—MOTORS—MIDGET CARS—BIKE MOTORS AND SIDECARS—MIDGET GARDEN TRACTORS. SAVE HUNDREDS OF DOLLARS WITH THESE PLANS! (Foreign orders $1.50)
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And that's not all . . . Bright Star batteries give 150% of the Light Industrial Test requirements as specified by the U. S. Gov't Bureau of Standards.

. . . and there are more BRIGHT STAR FLASHLIGHTS sold than any other make; they too have been best since 1909!

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GREAT NEW TOOL!

The world-famous Mead Bandsander *is* ideal for home workshop use! This remarkable machine quickly shapes, sands, carves and polishes wood, metal, plastics! Works equally well on **inside** cut-out openings or irregular outside edges. Gets at places no other can! Tilting table for bevelling, chamfering. Rust-and-sweat proof top. Ball bearings. Saves time, labor, money on jobs in any home or industrial shop. **Invaluable** to home-craftsmen, makers of patterns, tools, dies, signs, costume jewelry, castings, forgings, ornaments, radio and electrical parts, stampings, etc. Nothing else like it. Sold on 5 Day Trial, money back guarantee. Circular Free!

Shows use on inside cut-out openings

Cuts Fast and Clean Saves Filing, Sanding Work

Bandsander

THE MACHINE THAT AMAZED THE EXPERTS!

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Sand Casting—Forging—Heat Treating—Case Hardening

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is again available in limited quantity without priority. Orders filled in sequence as received. INVENTORS-SCHOOLS-CRAFTSMEN use FOUNDRYETTE for making castings quickly for new inventions, for instruction, and general purpose. Order now for early delivery. Three sizes are available capable of making bronze castings of 1½, 3, and 6 pounds weight, aluminum, copper, brass, etc. Domestic gas supply and 110 volt AC or DC energy required for operation. Write for circular.

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● Onan gasoline-engine-driven Electric Plants supply reliable, economical electric service for any use. Portable, stationary or stand-by models. Water or air-cooled, compact and rugged.

A.C.: 350 to 35,000 watts in all standard voltages and frequencies. D.C.: 400 to 10,000 watts, 115 and 230 volts. BATTERY CHARGERS: 500 to 3,500 watts; 6, 12, 24, 32 volts.

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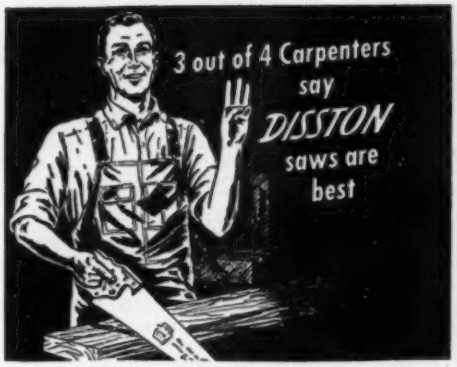

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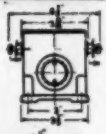

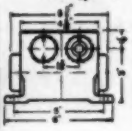

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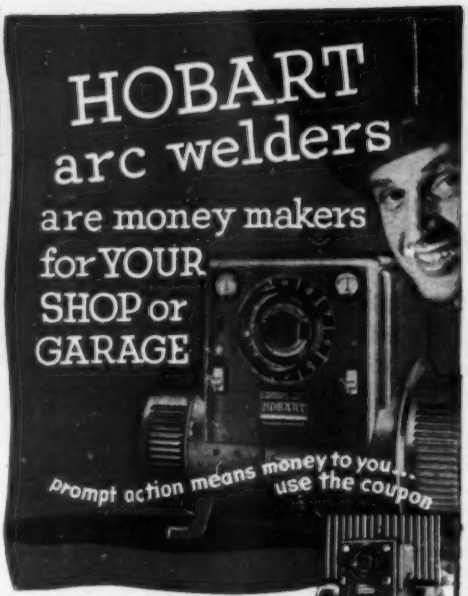

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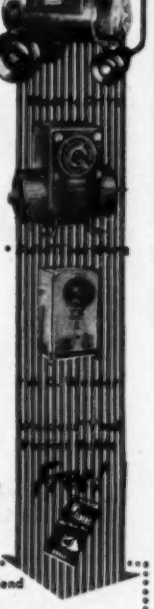

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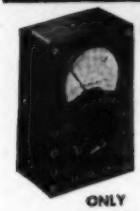

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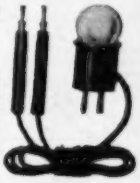

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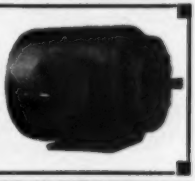

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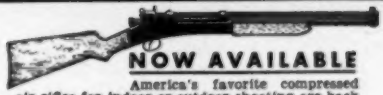

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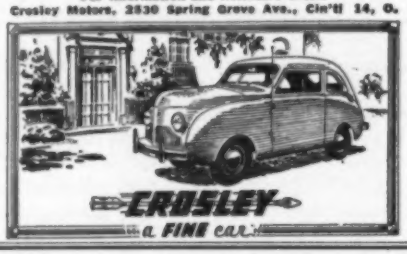

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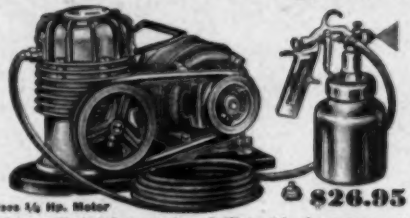

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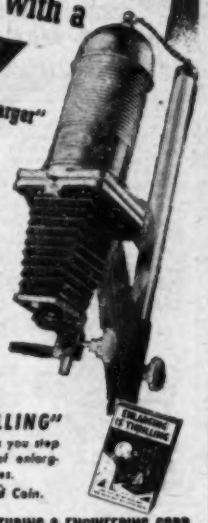

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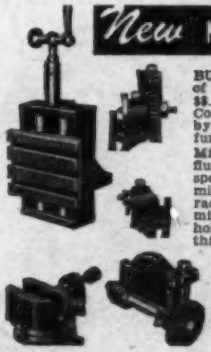

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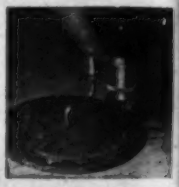

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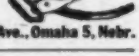

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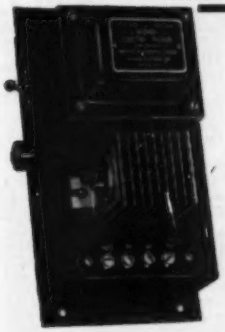

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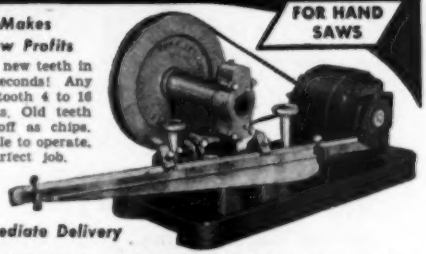

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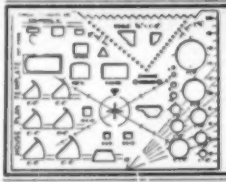

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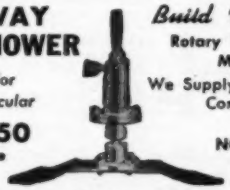

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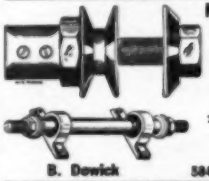

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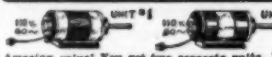

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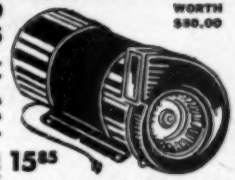

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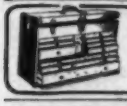

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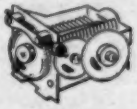

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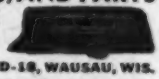

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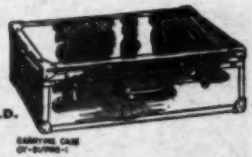

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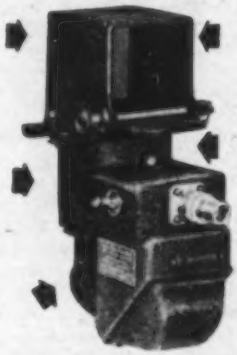

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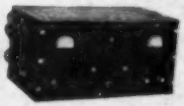

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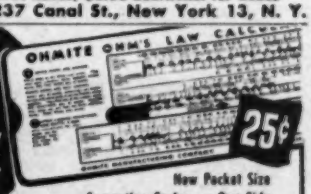

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6 TOOLS in One Amazing Wrench

HUNDREDS OF USES AS

- Adjustable end wrench
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- Gripping tool
- Multi-leverage pliers
- Hand vise
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BMC PRESSURE-LOCK WRENCH

it fits as it grips ... and it HOLDS!

Created by tool engineers in answer to a universal need for an all-around tool, this pressure-lock wrench grips nuts, studs, pipe, short, broken or irregular pieces and holds them with a 1½ ton grip. Releases with the flick of a finger. Readily adjusted to varying jaw openings. *Jaws always parallel when they close* . . . grip to the very tip. Saves time, tempers, avoids dropped pieces, rounded edges. At leading hardware, auto equipment, mill supply, plumbing and electrical stores and departments.

# 7—Max. jaw opening ¾"	2.45
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★ Offset Screwdrivers—for both Phillips and standard head screws.

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Go places for pennies . . . with a Whizzer Motor on your bike! This sturdy, modern motor fits any balloon tire bike . . . takes you 125 miles per gallon, at speeds up to 35 m.p.h. It's America's thriftiest power transportation, engineered for years of trouble-free performance! Get in the Whizzer Parade!

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ONLY $97.55 PLUS TAX

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WHIZZER

Whizzer Motor Company, Dept. 532, Pontiac, Michigan.
I enclose $99.97, which includes $2.42 Federal Excise Tax ( ) check or ( ) money order. Send me one Whizzer Motor complete, ready for installation.
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Costs only 3¢ A DAY · EACH ADULT
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Benefits begin the day you enter a hospital

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Hospital Expenses paid, up to (beginning with the first day)	$540.00
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Sickness or accident can easily wipe out, in a few weeks, savings it may have taken years to accumulate. Don't let this happen to you. With a Family Mutual Hospitalization policy you'll be able to pay your hospital bills. In case of accident, you will be reimbursed for your doctor expenses and for loss of time from work. You may choose any hospital in the United States and your own family doctor may attend you. Benefits applying to children are 50% of those paid adults.

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Please send me, without obligation, complete information on your Economical Hospitalization Plan.

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WOOD SHAPER

Of grey iron and aluminum construction. High speed New Departure Ball Bearings. 12 x 16 inch table with ½ inch spindle.

THREE WAY ADJUSTMENTS—Table adjusts up and down. Cutters are adjustable on the spindle. Fence is adjustable on the table.

Requires ⅓ to ½ hp motor and comes equipped with universal shaper head at $37.50. Extra shaper heads $6.00. Extra three wing cutters $2.30. Prices for the knives to fit shaper head on request, and according to size and pattern.

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CUTS INTRICATE DESIGNS
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ENLARGED SECTION OF BLADE

TYLER MANUFACTURING COMPANY
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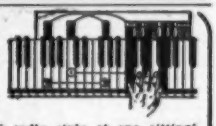
Play in One Hour by Ear and Note



NEWLY INVENTED SLIDE-CHORD DEVICE. Fits piano. Play any chord at once. Plink out tunes by ear and note and add chords to play beautiful 2-hand professional radio style at one sitting! Fun! A game! No exercise or drills. Startle your friends. PLAY 27 COMPLETE SONGS WITH 4 CHORDS (SEND NO MONEY) (JUST 1c CARD). 25 lessons ABC METHOD, including many POPULAR SONGS and SLIDE CHORD DEVICE ALL for $2 plus C.O.D. Save C.O.D. and send $2 cash, check, money order. MONEY BACK GUARANTEE. No C.O.D. in Canada.

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STEELS and ALUMINUMS with a motorboat tone

SINGLES, Chev, V-8, Plymouth, Steels $5.50, Aluminum $6.50. Chry., Olds., Buicks, etc., Steels $7.50, Aluminum $8.50. V-8 and MERCURY DUALS, Steel $17.50, Aluminum $20.00. Aluminums are guaranteed for life of your car.

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100 POUND HANDY ASSORTMENT SCREWS—NUTS—BOLTS WASHERS—RIVETS—SPRINGS $8.95

Think of it—this popular assortment specially priced at less than 9¢ a pound! Chest filled with 100 pounds of clean, new fasteners, mostly ¼" and larger diameters—bound to come in handy in shops, garages, on farms, or wherever a large variety is needed. Chest, too, is valuable for many uses after original contents have been used. Shipping wt. 115 lbs. Price only $8.95. Enclose remittance and shipping charges when ordering.

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New Power, Pickup, Pep!

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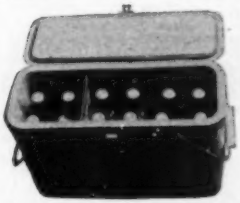

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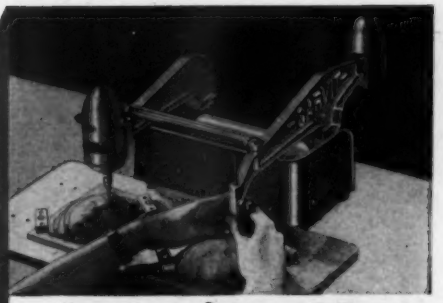

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Makes You a Skilled WOOD CARVER in Twenty Minutes!

A fascinating new hobby, complete in 1 tool!

Making fine wood carvings with a Carvit is so simple a child can do it! You can amaze your friends with finished work on your very first attempt. You can add a "professional" touch to other woodworking projects by embellishing them with fine carvings.

Fascinating Fun—and Profitable!

The Carvit is a duplicating tool, made by a famous manufacturer of precision industrial tools. With it you can carve dozens of beautiful and useful objects in mahogany, ebony, and other fine woods. For models, you can use plaques, costume jewelry, ash-trays, and a wide variety of other inexpensive objects of plaster, metal, glass and plastic. Your carvings are many times more beautiful and valuable than your models!

Think of the useful and ornamental things you can make for your own home — think of the distinctive gifts you can make for your friends!

You are an expert at once—with a Carvit!

Here's how the easy-to-use Carvit works: You clamp a model to the table below the tracer, and a wood block below the cutter. Then you switch on the motor and guide the tracer over the raised contours of your model. The cutter moves with the tracer to carve an exact duplicate of your model. That's all there is to it!

With a center attachment you can carve objects in the round—statuettes, busts, and figures.

The Carvit comes complete with cutters, wrenches, and instructions, ready to use, for $48.50. Center attachment extra.

Production is too limited to supply your local dealer, but while our stock lasts we can accept your direct order for immediate delivery. To avoid waiting for your new Carvit,

H-2 ***tear out this coupon and mail today!***

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10 DAYS FREE *Trial!*

Please send me —
☐ One Carvit complete as described above.
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(If I am not completely satisfied with my Carvit, I can return it in 10 days for a complete refund of the purchase price.)

☐ Enclosed is my check or money order, in the amount of $.....

☐ Ship C.O.D. plus insurance and postage.

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25 Asst'd CUTTERS, SAWS REAMERS, BORERS

$5.95

If you can duplicate this wonder value in any hobby shop at less than $15.00, return your set and get your money back.

This is the greatest value we have ever offered — 25 assorted hardened steel cutters for working on plastics, metals and wood. Assorted shanks 3/32, 7/64, and 1/8" diameters. The large illustration shows the tools actual size.

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Can be used for running tools, toys, experimental work, etc. A series wound motor 3¾" long x 2½" wide and 1¾" high. ¼" shaft. A resistor is included at no extra cost making this an AC-DC Motor.

Both above items Post Paid in U.S.A. and possessions

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Variable Power Eyepiece Adjustable from 10X to 40X. Lower powers for target spotting and wide angle viewing. Higher powers for long range and astronomy. Achromatic objective lens over 2 inches diameter. Length closed 9½", open 27". This is a precision American made instrument. Only $34.50 Postpaid.

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TELESCOPES — BINOCULARS — MICROSCOPES

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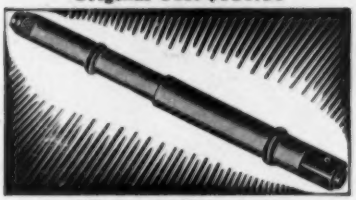
Original Cost $150.00



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ALL COATED LENSES—BRAND NEW

An ideal gift for viewing objects, landscapes, seashores, etc. The high resolving power of the six coated lenses, five of them achromats will bring out great details. For the experimenter it can be dismantled and used for hundreds of projects. Length 22½ inches. **Postpaid $7.50.**

500,000 Lenses and Prisms. Send 3 cent stamp for "BARGAIN" List.

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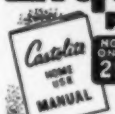

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YOU DO THIS

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- Hang more doors better.
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- Precision made.

Cost ONLY $1.75 each or $3.00 a set at your hardware store. If your Dealer can't supply you send only $1.00 with order and pay Postman balance, plus postage C.O.D.

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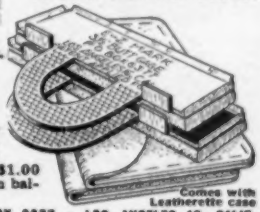
You get a clean cut deeply etched profile. Remove chips. Repeat this operation on the jamb and hang the door. THAT'S ALL—NO MORE!



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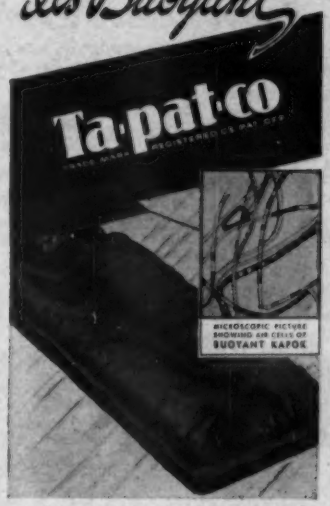

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K & W Radiator Seal—repairs leaky radiators immediately. **K & W Metallic Seal** and **Mechanical Method**—restore cracked heads and blocks to unimpaired service in just a few hours. **KERKLING & CO., Burbank, California.**

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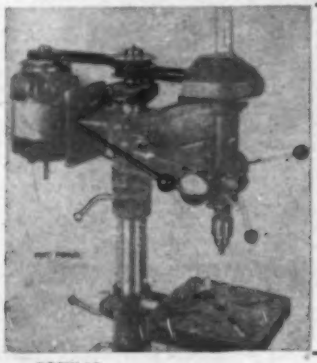

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Price — above Bronze bearing, $39.50; Ball bearing, $45.50

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MEN'S Wrist Watch

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TO: Reader
FROM: Editor

Unwritten Stories Are Also Important

A NEW YORK newspaper man once estimated that he read daily the equivalent of *Gone With the Wind;* for every thousand words read, he had one set in type.

Here at Popular Science we likewise do plenty of reading. We also get in our share of traveling. In the course of a year many of us cover thousands of miles, make dozens of trips. Naturally, they don't all pan out. We don't expect that they will all result in immediate stories, but we do feel that some time the information gained and new friends made will benefit PSM readers.

Over a recent 11 days, for example, a PSM editor flew 15,000 miles to Sao Paulo and Rio de Janeiro, Brazil, and return. He was one of 10 magazine and newspaper men invited to inspect the plants of Laminacao Nacional de Metais. After less than five days on the ground his thoughts were jumbled and his senses weary, but he had gained at least one new conviction: Citizens of the United States have no monopoly on the term "American."

As individuals and as a nation we have used "American" to denote much more than citizenship in the U.S.A. We have meant, too, resourcefulness, initiative, youth, fearlessness, adaptability, ambition and freedom. Well, Brazilians are like that too. We were astounded, for instance, to learn that the active directing heads of Laminacao boast an average age of 30. They employ more than 8,000 men and women, produce light airplanes, kitchenware, nonferrous strips and plates, high-quality zippers, and steam boilers. Does anyone know an "American" outfit like that whose bosses are less than 10 years out of college?

Francisco Pignatari, 29-year-old Brazilian aviator and industrialist who heads the huge Laminacao Nacional de Metais, is typical of its young leaders.

The whole tempo of the expedition, in fact, was "American." The schedule of luncheons, receptions, dinners and especially interviews by the press left the guests breathless but impressed. The amiable, brisk, English-speaking hosts never once relaxed their efforts to exhibit their industries, dispense their hospitality, and show the incredible beauty of Rio harbor and the Sao Paulo countryside.

North American influence was unmistakable, even to the extent of a slight Boston accent in a young engineer, Oswaldo Barboza, who had studied aeronautical engineering at M.I.T. Besides designing the only light planes produced in Brazil, Barboza enjoys a particularly robust "American" sense of humor, plays four and five games of chess simultaneously, and seems to be an expert at bridge and poker. Others had studied at Pittsburgh and Cincinnati.

Yet for all the time spent, the very attractive new friends made, there really is no "story" for PSM readers in this trip. North American machines and techniques are different. For the most part, too, they have a head start on Brazil's whose problem is to produce more goods, more cheaply and more quickly. Brazilian engineers and scientists, able as they are, have different tasks from those they would have in the United States. They are essentially pioneers, because their frontiers are undeveloped lands and resources, like our own country 75 years ago.

Fred Newman

No moisture can seep through the seams of these raincoats—thanks to the electronic sewing machine developed at RCA Laboratories.

A sewing machine...without a needle or thread!

Since mankind first began to sew, say 15,000 years ago, seams have always meant "needle and thread."

But when thermoplastic materials came along—developed for waterproof coverings such as raincoats—"needle and thread" seams wouldn't do because of their tiny holes.

Now—thanks to research at RCA Laboratories that constantly seek to improve even "little things"—goods made out of thermoplastics are "sewn" by electrons and the seams are as strong as the material itself!

This will make possible dozens of new uses for these inexpensive and durable thermoplastic materials. Even today they provide perfect packages for foods, meats and drugs because they're watertight, airtight and transparent. You've probably seen thermoplastic raincoats, tobacco pouches, shower curtains . . .

Research, such as resulted in the electronic sewing machine, is reflected in all RCA products. When you buy anything bearing the name RCA, you enjoy a unique pride of ownership in knowing that you possess one of the finest instruments of its kind science has achieved.

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to The RCA Victor Show, Sundays, 2:00 P.M., Eastern Time, over NBC Network.

The electronic sewing machine "welding" seams. Anyone interested in manufacturing this instrument can obtain information by writing to RCA, RCA Bldg., Radio City, New York 20, N. Y.

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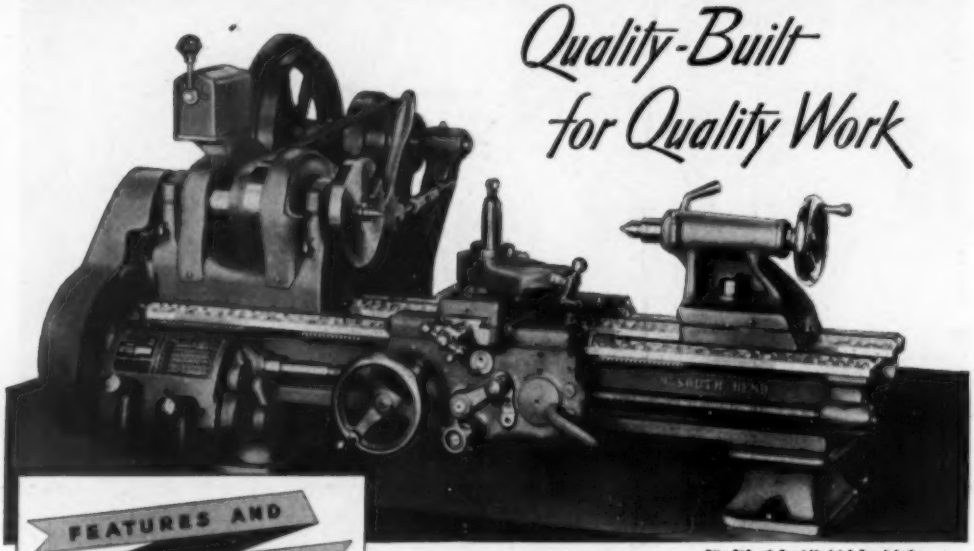

9" x 3' South Bend Model A Bench Lathe

FEATURES AND SPECIFICATIONS

SWINGS—9¼" over bed and saddle wings
5½" over saddle cross slide

BED LENGTHS—3, 3½, 4 and 4½ feet

DISTANCE BETWEEN CENTERS—16 to 34 inches

SPINDLE SPEEDS—
depending on type of drive equipment
Six—41 to 658 r. p. m.
Twelve—41 to 1270 r. p. m.
Sixteen—46 to 1176 r. p. m.

POWER LONGITUDINAL FEEDS—
Model A Lathes—48, .0015" to .0853"
Model B Lathes—26, .0021" to .0155"
Model C Lathes—14, .0021" to .0156"

POWER CROSS FEEDS—
Model A Lathes—48, .0004" to .0252"
Model B Lathes—23, .001" to .0046"
Model C Lathes—manual operation

THREAD CUTTING RANGE—
Model A Lathe—48 pitches,
4 to 224 per inch
Models B and C Lathes—45 pitches,
4 to 160 per inch

MAXIMUM COLLET CAPACITY—½ inch

QUICK CHANGE GEAR BOX—Model A Lathes

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The quality that is built into South Bend 9-inch Precision Lathes enables them to produce quality work with efficiency under all conditions. Regardless of the type of machining—between-centers, collet, fixture, or chucking—close tolerances can be maintained and a maximum volume of fine work produced with a minimum of effort.

Write for Catalog 9-J which fully describes and illustrates all South Bend 9" Precision Lathes and attachments.

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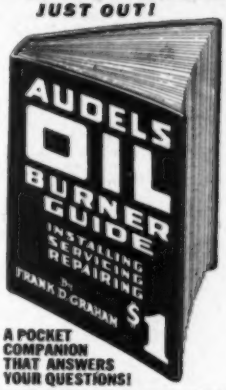

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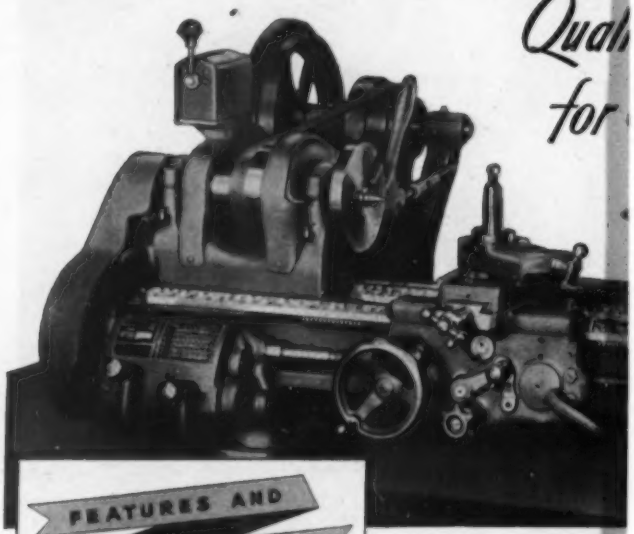

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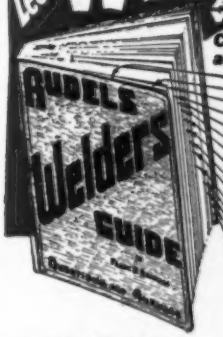

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